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AUGUST—1948

No. 153

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CABLE ADDRESS—TESTING

Number 153 August 1948

Notable Sessions at 1948 Annual Meeting

Outstanding Symposiums, Almost 400 Committee Meetings and Two Exhibits Feature 51st Annual Meeting

THE 1948 Annual Meeting held in Detroit during the week of June 21 was outstanding in a number of respects. There were several notable technical symposiums arranged by some of the A.S.T.M. technical committees and specially appointed symposium groups. The two exhibits, one covering testing apparatus and related equipment, the other a photographic exhibit, were of outstanding interest, and beginning at the very outset of the meeting, in fact over the week end preceding and extending through the very last day were numerous technical committee meetings, this year aggregating almost 400, more than ever before.

As a result of the committee meetings and the sessions, with the other meeting features, much impetus has been given to the Society's work in the field of standardization and research in materials.

The task of recording in succinct and readable fashion a news account of major developments at the meeting is becoming almost an insurmountable one as the meeting grows in size and complexity. However, an attempt is made in the material which follows to summarize some of the general features of interest to many of the members, and then there are condensed accounts of some of the major committee activities and those of interest in specific fields.

Actions on Standards

It will be noted from the accompanying table giving a summary of actions taken at the Annual Meeting that 67 proposed specifications and tests were approved as tentatives and that upwards of 75 existing tentatives are being referred to letter ballot of the Society for adoption as formal standards. Many existing tentatives and full standards were revised. Details of the various actions and recommendations appeared in the reports of committees, and a *Summary of Proceedings* which will accompany the Society letter ballot to be distributed in August gives an official record of the actions taken in the various sessions. Because of a ruling by the Board that no actions would be referred to the Annual Meeting unless they had been covered in the preprinted reports, the number of last-minute changes were kept to a minimum. This has the effect of reducing the volume of material necessary to cover in the Summary and also it aided in streamlining the business sessions at the meeting.

A list of the new and extensively revised tentative specifications and tests appears later in this BULLETIN. Many members are particularly interested in the serial designations assigned these items and this list provides that information.

With the actions consummated at the Annual Meeting, the Society now has close to 1500 standards and tentatives on its books, and it will be noted from the article on "Current Standardization Activities" elsewhere in this issue that a large number of other specifications and tests are being drafted, many of which will probably be submitted to the Administrative Committee on Standards for approval during the fall and winter. All of the new and revised specifications and tests will appear in the 1948 Supplement to the Book of Standards, they will be available in separate pamphlet form, and a number will appear in some of the special compilations of standards (see article on "Publication Schedule" for information on these books).

Attendance

The accompanying table gives registration data for several recent meetings and also covers the 1935 Annual Meet-

New President

R. L. Templin

New Vice-President

L. J. Markwardt

ing in Detroit. The 1948 meeting was the fourth highest with respect to registration figures. Attendance at the exhibit and in the technical sessions was excellent—in fact the sessions appear to have been better attended than at any recent annual meeting.

REGISTRATION—ANNUAL MEETINGS

	Year	Members	Committee Members	Visitors	Total	Ladies
Detroit	1935	659	107	246	1012	124
New York	1944	1185	368	510	2063	30 to 40
Buffalo	1946	978	405	452	1835	About 100
Atlantic City	1947	1071	469	246	1786	320
Detroit	1948	1160	358	250	1768	133

New Officers

Results of the letter ballot on election of new officers were announced at the Dinner by the Chairman of the Tellers' Committee, H. A. Wagner. The newly elected members of the Board of Directors who were present were introduced, as was the new President, R. L. Templin, Aluminum Company of America. The new Vice-President, L. J. Markwardt, U. S. Forest Products Laboratory, was not at the meeting because of attendance at an International Forestry Conference in Switzerland. Photographs of the new officers and biographical material appear elsewhere in this BULLETIN.

Annual Dinner and Dance; Ladies' Entertainment; Activities of Local Committee on Arrangements

Much credit for the outstanding success of the Annual Meeting should go to the Committee on Arrangements which functioned under the Detroit District Council. This group, headed by C. H. Fellows, Detroit Edison Co., with V. M. Darsey, Chairman of the Detroit District, as vice-chairman, carried through an outstanding ladies' entertainment program and arranged the interesting annual dinner and dance at which were present some 300 members and their families and guests. Expenses for these affairs were in a large measure underwritten by a fund raised through the local Finance Committee, and a list of sponsors appears in this BULLETIN. C. E. Heussner, Chrysler Corp., as chairman, with R. B. Saltonstall, The Udylite Corp., as vice-chairman, were responsible for the annual dinner and entertainment. J. L. McCloud, Ford Motor Co., and F. G. Weed, Rinshed Mason Co., headed the Apparatus and Photographic Exhibits group. F. C. Kennedy, U. S. Rubber Co., was chairman of the Committee on Publicity and Promotion, and C. M. Gambrill, Ethyl Corp., was responsible for housing arrangements and also had a very active part in the Committee D-2 dinner and activities. The perplexing problem of local transportation was capably handled by F. B. Zimmerli, Barnes-Gibson-Raymond Division of Associated Spring Corp., the new chairman of the Detroit District. His committee also took care of any special visits requested. The Finance Committee which did a great deal of work, was headed by B. C. Case, Hanson-Van Winkle Munning Co. Mrs. T. A. Boyd headed the Hostess Committee. Cooperating in general plans also was Harvey A. Wagner, of the Detroit Edison Co., who served as secretary of the Detroit Committee on Arrangements.

A resolution of appreciation by the A.S.T.M. Board of Directors appears on page 31.

The committee arranged for printing a very attractive ladies' entertainment program and the dinner program, the latter being furnished through the courtesy of the Ethyl Corp.

At the dinner where local Chairman C. H. Fellows presided, the newly elected officers present were introduced, three Honorary Memberships were awarded as noted elsewhere in this issue, and the President's Address was given. This is printed in the technical section of this BULLETIN. After the dinner, about 150 of the guests stayed for the dance in the Wayne Room of the Statler where the music of Jack Rosevear and his orchestra was enjoyed by all.

Awards

This year the Charles B. Dudley Medal and the Richard L. Templin Award were presented on Thursday Evening, June 24, during the Edgar Marburg Lecture session. The Charles B. Dudley Medal, which is made to the author or authors of a paper of outstanding merit constituting an original contribution on research in engineering materials, and which was established as a means of stimulating research in materials and of recognizing meritorious contributions, commemorating the name of the first President of the Society, was made to P. R. Toolin, Research Engineer, Mechanics Department, Westinghouse Research Laboratories, East Pittsburgh, Pa., and N. L. Mochel, Manager, Metallurgical Department, Westinghouse Electric Corp., Lester, Philadelphia, Pa., for their paper on "The High-Temperature Fatigue Strength of Several Gas Turbine Alloys," presented at the 1947 Annual Meeting and published in the 1947 *Proceedings* of the Society.

The Richard L. Templin Award, established in 1945, is made for outstanding papers describing new testing methods and apparatus. The purpose of the award is to stimulate research in the development of testing methods and apparatus, to encourage the presentation to the Society of papers describing new and useful testing procedures and apparatus, and to recognize meritorious efforts of this kind. This year the award was made to A. G. H. Dietz, G. S. Burr, W. J. Gailus, J. O. Silvey, and S. Yurenka, Massachusetts Institute of Technology, Cambridge, Mass., for their paper on "Universal Plastics Testing Machine," published in the 1947 *Proceedings*.

The Sanford E. Thompson Award, presented at the Friday afternoon session covering Cement, Concrete, and Concrete Aggregates, was this year given to W. C. Hanna, Chief Chemist and Chemical Engineer, California Portland Cement Co., Colton, Calif., for his paper on "Unfavorable Chemical Reactions of Aggregates in Concrete and a Suggested Corrective," presented at the 1947 Annual Meeting and published in the *Proceedings*. This award was established in 1938 by Committee

SUMMARY OF ACTIONS TAKEN AT ANNUAL MEETING AFFECTING STANDARDS AND TENTATIVES

	Existing Tentatives Adopted as Standard	Standards in Which Revisions Will Be Adopted	New Tentatives	Tentative Revisions of Standards	Existing Tentatives Revised	Standards and Tentatives Withdrawn	Present Total Standards Adopted	Present Total Tentatives
A. Ferrous Metals—Steel, Cast Iron, Wrought Iron, Alloys, etc.	1	12	5	1	9	0	155	70
B. Non-Ferrous Metals—Copper, Zinc, Lead Aluminum, Alloys, etc.	15	9	12	5	22	0	86	102
C. Cement, Lime, Gypsum, Concrete, and Clay Products	14	6	4	7	4	3	136	27
D. Paints, Petroleum Products, Paper, Textiles, Rubber, Soap, etc.	40	24	46	8	37	8	527	311
E. Miscellaneous Subjects, Testing, etc.	5	0	0	3	1	0	35	40
Total	75	51	67	24	73	11	939	550

C-9 on Concrete and Concrete Aggregates as an annual token of recognition to the author or authors of a paper of outstanding merit on concrete and concrete aggregates presented at an annual meeting of the Society. The award is named in honor of the first chairman of the committee and this year the award was presented by Dr. Thompson. The remarks of Dr. Thompson, in presenting the award to Mr. Hanna, are recorded in an adjoining column.

Photographs of the winners of these awards and brief biographical material are given on page 19.

Notes on Symposiums and Technical Sessions

Of the 19 sessions constituting the official program for the meeting, nine comprised or included formal symposiums with groups of technical papers by leaders in their respective fields. The article on publications later in this BULLETIN will give some idea of the symposiums and special publications which will be issued later in the year, and these special publications and the *Proceedings*, of course, will provide members with the complete papers and the extensive written and oral discussion presented. The Symposium on Mineral Aggregates included the largest number of individual contributions, there being 14 papers. While this was held in one session, another symposium, the one on magnetic testing, required two sessions so that the subject might be covered in the detail the committee desired. In addition to the symposiums there were other discussions of particular interest including some held at meetings of technical committees. Special mention might be made of the round-table discussion on ultra-sonic testing, sponsored by Committee E-7. A large audience heard two prepared discussions, one by Charles Hastings, Watertown Arsenal, the other by Dr. Wesley Irwin, General Motors Research Laboratory. Following these talks which were somewhat fundamental, Dr. Gold of Brown University spoke and then there were comments by a number of those present. In introducing the session Dr. H. H. Lester, the retiring Chairman of Committee E-7, stressed the importance of nondestructive testing, particularly when production is expedited as in a war effort; inspection must be adequate but must definitely not create bottlenecks because when it does it may become superficial or be disregarded entirely.

A symposium of particular interest to the metals people was the one covering metallography in color. This comprised five papers with discussion and, of course, in the presentation the authors used many illustrations showing unique results from the use of color. One of the objectives of this symposium was to record practices on how those using color are proceeding. The speakers described some of the fundamental requirements of the microscope so that good color work would result. Others touched on the techniques of photography and then there were discussions on applying color photomicrography in everyday work. This symposium is to be published and it will include a number of color insert plates.

Another symposium of particular interest to those in the metals field is the one on magnetic testing which had been arranged by Committee A-6. The objective here was to present latest thoughts and practices in this field in which there has been a steadily growing interest, and the 10 papers together with discussion covered the field rather thoroughly.

A subject which comes as near as any to being of universal concern to all groups and interests in the Society is that of quality control. A.S.T.M. Committee E-11 on Quality Control is doing a great deal to bring out clearly some of the salient features of this subject, and references have been made in the BULLETIN and E-11 committee report to some of the important activities under way. Essential in this work is an understanding of samples and sampling, and the 1948 Symposium on the Usefulness and Limitation of Samples should perhaps be "must" reading for large groups of our members and committee people. The committee in charge of the symposium obtained experts in this field who not only were conversant with the theory and application but who had the abilities to get the ideas across on a practical level. The ensuing publication should reflect this quality.

There is no question about the increasing interest in use of quality control methods. The greatest stimulus, as Colonel Simon, one of the speakers in the discussion, pointed out, probably came out in the war, and during the wartime sampling techniques were developed which aided in placing the acceptance of materials on a real scientific basis that made manufacturers feel they were getting a square deal. Many colleges are today giving courses in statistical methods although they may not be listed under this terminology, and the biggest hope in propagating quality control unquestionably lies in the colleges, according to Colonel Simon.

Other Sessions on Metals, Etc.

Some of the failures of materials and construction, particularly of certain types of ships in World War II, have led to a great deal of research and investigation, much of which is still under way. One of the problems is to develop a satisfactory test or tests which will evaluate the ductility or tendency of material to pull apart, other than the usual standard mechanical tests which have been used. The Fifth Session at the Annual Meeting was devoted to a Symposium on Deformation of Metals as Related to Forming and Service, sponsored by the Administrative Committee on Simulated Service Testing. The aim was to focus attention on some of the newer methods of tests which have been investigated to give us a better picture of the fundamental problems involved in plastic deformation and flow. During the symposium there was considerable discussion of notch sensitivity characteristics of materials, and there was much inter-

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est in whether the authors of the papers and others felt that any of the current tests might be displaced by some of the newer tests described.

For many years there have been one or more sessions at annual meetings on the effect of temperature on the properties of metals. The one this year featured several papers and the report of the Joint A.S.T.M.-A.S.M.E. Committee on Effect of Temperature on the Properties of Metals. Among the papers of much significance that were included was one on "High Temperature Properties of Rotor Disks for Gas Turbines as Affected by Variables in Processing," and one on "Fatigue and Static Load Tests of an Austenitic Cast Iron at Elevated Temperatures."

Functional Tests for Ball-Bearing Greases

Following an interesting paper on bearing corrosion tests, there was held in the Eighth Session of the meeting the Symposium on Functional Tests for Ball-Bearing Greases. R. C. Adams, the Session Chairman, in introducing the symposium, pointed out that the principle has been quite generally accepted, but that many problems have developed in practical use of a functional test. There is a multiplicity of equipment in use and various ideas on the results obtained. The purpose of the symposium was to provide an opportunity for discussion of the various methods and equipment used by different workers in this field, and the committee in charge elicited discussion from a much wider group of technologists concerned. The general aim in all of this work is to develop a good simulated service test that will give reasonable correlation between service and laboratory tests, but there are many problems to be solved. The symposium focused attention on a number of these and indicated that much progress is being made.

Speed of Testing

Committee E-1 on Methods of Testing, through its section on Speed of Testing, had held an informal round-table discussion at the 1947 Annual Meeting preparatory to its formal symposium in Detroit. Prior to the symposium, J. R. Townsend, Chairman of Committee E-1 on Methods of Testing, described the work of the committee which is under way and noted some of the problems, pointing out that the objective is to coordinate and simplify work that may be under way in a large number of A.S.T.M. technical committees, in the interests of over-all standardization and simplification. P. G. McVetty, Session Chairman, noted that the purpose of the Speed of Testing symposium was to stimulate further study to result in improving our speed requirements in specifications. Some materials are not greatly affected by quite a variation in speed of tests, and in others speed may be quite important. In the one case, then, unnecessary restrictions increase the costs considerably, and in the other a lack of agreement may result in rejections, delays, and higher costs.

Sessions on Construction Materials

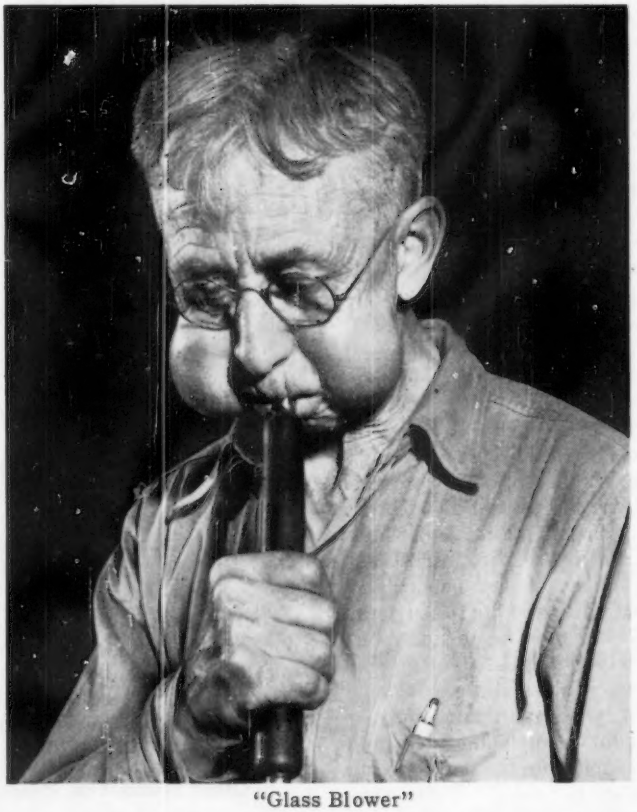
Four annual meeting sessions were built around symposiums and technical papers dealing with various materials used in the construction field. Possibly the most comprehensive was the Symposium on Mineral Aggregates, comprising 14 papers prepared by outstanding authorities and covering many phases from the distribution of mineral aggregates in the U. S., through their characteristics and properties, grading, production and manufacture, and uses, to research still needed. An attendance of well over 200 indicated the interest in this subject. All papers were presented by summary only due to the limited time available, but are to be published.

The presentation of the Symposium on Methods and Procedures Used in Identifying Reactive Materials in Concrete drew a capacity attendance because of the emphasis and significance that is now being given to the effect on the durability of concrete of these constituent materials. Committee C-9 on Concrete and Concrete Aggregates sponsored this symposium which discussed several ways of identifying and testing potentially reactive materials.

A session comprising several papers on cement, concrete, and concrete aggregates augmented the sessions previously described, in presenting additional research data and discussion on these same materials. A feature of this session was the presentation of the Sanford E. Thompson Award to W. C. Hanna, Chief Chemist and Chemical Engineer, California Portland Cement Co., for the outstanding paper presented before the Society in 1947 on the subject of concrete.

Three papers prsented as part of the Ninth Session drew very favorable attention and discussion. A paper relating to the testing of magnesium oxychloride cements, one of the new fields now covered by A.S.T.M., outlined "New Type Weighted Needles for Determining the Setting Times of Magnesium Oxychloride Cements." "Testing Surface Waterproofers" and "Factors in the Resistance of Brick Masonry Walls to Moisture Penetration" proved of great interest due to the important part that these subjects play in successful building construction and maintenance and the problems which they present in proper analysis and solution.

(Continued on page 10)



"Glass Blower"

First prize-winning photograph, General Section, General Interest Group, in the Sixth A.S.T.M. Photographic Exhibit, by John Kalinich, Corning Glass Works.

Simon Collier | L. C. Beard, Jr. | T. P. Dresser, Jr. | H. K. Nason | E. W. Fasig

New Officers

THE RECENT election of officers, as announced at the Annual Meeting by the tellers, resulted in the unanimous election of Richard L. Templin as President (1948–1949), L. J. Markwardt as Vice-President (1948–1950), and the following as Directors (1948–1951): Leslie C. Beard, Jr., Simon Collier, Theodore P. Dresser, Jr., Howard K. Nason, and Edgar W. Fasig. Biographical material on these seven men follows:

President

RICHARD L. TEMPLIN, the new President, is Assistant Director of Research and Chief Engineer of Tests, Aluminum Company of America, New Kensington, Pa. A native of Kansas, Mr. Templin studied engineering at the University of Kansas, receiving his degree of B.S. in Civil Engineering in 1915. For postgraduate work at the University of Illinois he was awarded the degree of M.S. in Theoretical and Applied Mechanics in 1917. After two years with the National Bureau of Standards in Washington, D. C., Mr. Templin came to Pittsburgh in 1919 to join the staff of the Aluminum Company of America, as Chief Engineer of Tests. Since that time he has had the additional responsibility of Assistant Director of Research, beginning in 1942. Throughout these years he has been personally responsible for the development of many of the testing methods that are used today in the inspection and quality control of aluminum products. He has conceived and designed much of the physical testing equipment used in Alcoa's twenty-one mechanical testing laboratories.

A member of numerous A.S.T.M., A.S.C.E., and A.S.M.E. committees, Mr. Templin is interested in many phases of aluminum activity. He holds a number of patents on aluminum fabrication and testing equipment, and is the author of many papers and reports describing work in the non-ferrous and other fields. One of his best known achievements was the building of a model of the Calderwood (Tenn.) Dam, from the building of which many data were obtained regarding the physical characteristics of dams of this type.

In 1934, A.S.T.M. awarded Mr. Templin the Chas. B. Dudley Medal for his outstanding research paper on "Fatigue." In October, 1936, he was awarded jointly with A. V. Karpov, the Thomas Fitch Rowland prize for a paper describing the building and testing of a model of the Calderwood Arch Dam. In 1940, The Franklin Institute of the State of Pennsylvania gave him the Edward Longstreth Medal for his development work in the field of deformation recording apparatus.

For many years and particularly during World War II, Mr. Templin has been active in numerous phases of investigational work concerned with the use of aluminum in aircraft, and in other vital military applications. He is a member of the National Advisory Committee on Aeronautics committees concerned with the structural design of aircraft.

In A.S.T.M. his membership dates from 1917. Mr. Templin has been particularly active in the technical committees on die-cast metals and alloys, on light metals and alloys, and in work on methods of testing. He has been a member and officer of numerous subcommittees. Two of his recent activities involve work on simulated service testing and fatigue. He has written a large number of technical papers, several of which were published in the A.S.T.M. *Proceedings*. A member of the Board of Directors, 1936–1939, he was elected an A.S.T.M. Vice-President in 1946.

He is a member of the American Society of Civil Engineers, The American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society for Metals, and the Society for Experimental Stress Analysis.

Vice-President

L. J. MARKWARDT, the new Vice-President, is Assistant Director, U. S. Forest Products Lab., Madison, Wis. Born in Lansing, Iowa, Mr. Markwardt is a graduate of the University of Wisconsin in Civil Engineering, receiving a B.S. degree in 1912 and the C.E. degree in 1922. Except for an interim period of three years when he served as a member of the faculty of the Engineering College of the University of Wisconsin, he has been in engineering research work at the U. S. Forest Products Laboratory at Madison since 1912. Prior to his appointment as Assistant Director in 1943, Mr. Markwardt was in charge of the Division of Timber Mechanics, and directed the Laboratory's extensive engineering research on wood and wood-base materials. During World War II many important investigations were made there, including the development of design criteria for aircraft and uses of wood for other war purposes. Included also were studies of so-called sandwich materials, which are now attracting wide attention. Mr. Markwardt is the author of numerous bulletins, papers, and articles dealing with the properties and engineering uses of wood—four of his technical bulletins for the Department of Agriculture have involved strength and related properties of wood grown in the United States and Alaska. He also is co-author of a textbook on "Descriptive Geometry."

He has been a member of A.S.T.M. since 1920, and while he has been particularly active in the work of Committee D-7 on Wood, of which he has just been elected Chairman, and of Committee E-6 on Methods of Testing Building Constructions, of which he served as Chairman, he is also active in the work of other A.S.T.M. groups, including Committee D-10 on Shipping Containers, and Committee C-19 on Structural Sandwich Constructions. He has just completed a term as member of the A.S.T.M. Board of Directors, and served as Chairman of a Special Study Committee of the Board on Structural Sandwich Construction to consider the need for work of the Society in this field. In 1943 he delivered the Edgar Marburg Lecture on the subject, "Wood as an Engineering Material."

In addition to his affiliation with A.S.T.M. he is a member of the following organizations: American Society of Civil Engineers, National Society of Professional Engineers, American Railway Engineering Association, Society of American Foresters, Forest Products Research Society, American Association for the Advancement of Science, Tau Beta Pi, Sigma Xi, Chi Epsilon, and the Rotary Club.

He also has been active internationally in projects relating to standardization of methods of testing wood and wood-base materials, and is a member of the Subcommittee on Mechanical Wood Technology of the Food and Agriculture Organization of the United Nations, and of the International Union of Forest Research Organizations.

New Members of Board of Directors

LESLIE C. BEARD, JR., Chemist, and Assistant Director of Laboratories, Socony-Vacuum Oil Co., Inc., New York, N. Y., received his A.B. degree from Johns Hopkins University in 1919, and his Ph.D. in 1922. He is a native of Maryland, having been born in Hagerstown. In the Chemical Warfare Service in 1918, Dr. Beard was later Instructor in Chemistry at Johns Hopkins, and on the faculty of Baltimore College of Dental Surgery.

He became Research Chemist of Standard Oil Company of New York in 1923, being appointed Supervisor of Research in 1930. He has been Assistant Director of Socony-Vacuum Labs. since 1933.

A member of A.S.T.M. for many years he has been particularly active in Committee D-2 on Petroleum Products and Lubricants, serving on many of its subcommittees, having been chairman of several of them. He was formerly a member and officer of the New York District Council, and since 1946 has been a member of the Administrative Committee on Research.

His other memberships in addition to A.S.T.M. are the American Chemical Society, American Association for the Advancement of Science, and Phi Beta Kappa.

SIMON COLLIER, Director of Quality, Johns-Manville Corp., New York, N. Y., and a native of Massachusetts (born in Salem), graduated from Worcester Polytechnic Institute with a B.S. in Chemistry in 1916. He was in charge of the rubber work at the National Bureau of Standards from 1919 to 1923. He was employed in 1923 as Chief Chemist at the Waukegan Plant of Johns-Manville, and then became Manager of the Quality Control Dept. In 1936 he was transferred to New York to organize a Central Inspection and Control Dept. for the entire company. In 1946 Mr. Collier was appointed Director of Quality Control for the entire company.

A member of A.S.T.M. for many years, Mr. Collier has been actively concerned with Committee D-11 on Rubber and Rubber-Like Products since 1927. Chairman of the main Committee since 1944, he has been chairman of the subcommittee on Chemical Analysis of Rubber Products and has served on numerous other subcommittees. He serves on the D-11 Subcommittee on Nomenclature and Definitions and A.S.T.M. Committee C-19 on Structural Sandwich Constructions.

His memberships other than A.S.T.M. include the American Chemical Society, the American Institute of Chemists, and the American Society for Quality Control.

THEODORE P. DRESSER, JR., Chief Engineer, Abbot A. Hanks, Inc., San Francisco, Calif., was born in Medford, Mass. He received his elementary and high school training in the public schools of Boston and studied Mining Engineering at the University of California, Berkeley. For several years he was employed in engineering projects in connection with the inspection and the testing of materials on road, tunnel, wharf, and building construction. He was appointed to his present position in 1917, and has been continuously connected with inspection, testing, and research in the field of materials and related construction problems. The work under his direction has included concrete and earth dams, concrete and steel structures, pipe lines, foundation investigations, problems involving soil mechanics, metallurgical investigations, corrosion problems, and specification writing, in addition to the general testing of materials.

He has been the representative of his firm in A.S.T.M. since 1917, is a member of the Administrative Committee on District Activities, active in the affairs of the Northern California District Council since the organization in 1930, and is a member of Committee D-18 on Soils for Engineering Purposes.

His other society affiliations include the American Society of Civil Engineers, Structural Engineers Association of Northern California, American Concrete Institute, Engineers Club of San Francisco, and the Commonwealth Club of California.

HOWARD K. NASON, Associate Director, Central Research Dept., Monsanto Chemical Co., Dayton, Ohio, is a native of Kansas City, Mo. His technical education was obtained at Kansas City Junior College, University of Kansas (A.B. in Chemistry), and Washington University.

From 1932 to 1936, he was Chief Chemist for Anderson-Stolz Corp., Kansas City, where he did research work on industrial water and boiler feedwater treatment and on protective coatings. He has been associated with Monsanto since 1936; served as Research Chemist in the St. Louis laboratories of the company from 1936 to 1939, specializing in plasticizers, industrial microbiology, and application research. From 1939 to 1944, Mr. Nason was Assistant Director of Research of Monsanto's Plastics Division in Springfield, Mass., where he was concerned with all phases of plastics research, development, manufacture, and application, and did pioneering work on the mechanical properties of plastics, in collaboration with T. S. Carswell, David Telfair, and others. From 1944 to 1946 he was Director of Development of the Central Research Dept. in Dayton, and since October, 1946, Associate Director of these laboratories.

Mr. Nason is recipient of a certificate of commendation from the American Standards Association in recognition of contributions to the development of standards for Army and Navy electronic equipment and of work done as a member of the Association's War Committee on Radio.

In A.S.T.M. he has been active for many years, particularly in Committee D-20 on Plastics, and Committee D-9 on Electrical Insulating Materials. He is a former vice-chairman of the plastics committee and served on many of its subcommittees. He also served on many subgroups of Committee D-9. He is active in the work of Committee D-14 on Adhesives, and serves on Committee D-1 on Paint. He is also rendering important service to the Society on its Administrative Committee on Papers and Publications.

In addition to A.S.T.M. he is affiliated with the American Chemical Society, the Society of Rheology, the Chemists' Club, the American Association for the Advancement of Science, the Division of High-Polymer Physics of the American Physical Society, The American Society of Mechanical Engineers, and the Plastics Materials Manufacturers' Association.

EDGAR W. FASIG, General Superintendent, Lowe Brothers Co., Dayton, Ohio, was born in Allen County, Ohio. Mr. Fasig received his A.B. degree in chemistry from Ohio State University, where he attended both the Engineering and Arts Colleges. During World War I he was in the Chemical Warfare Service as a First Lieutenant. He has been with Lowe Brothers Company for many years, having been Assistant General Superintendent prior to his appointment as General Superintendent in 1931.

Affiliated with A.S.T.M. since 1924, he is a member of Committee D-1 on Paint, Varnish, Lacquer, and Related Products, serving on several of its subcommittees, and is at present chairman of its advisory committee. He served for several years on the Committee on Naval Stores, and on the Administrative Committee on Papers and Publications.

He is a member of many national and local scientific and civic organizations. He is past President of the Federation of Paint and Varnish Production Clubs, and is current president of the Federation's 25-Year Club. He is Chairman of the Scientific Section Committee of the National Paint, Varnish & Lacquer Association. He is a past President of the Dayton Section of the American Chemical Society; and past President of the Miami Valley Chapter of the American Institute of Chemists. He is a member of the Oil and Colour Chemists Association, the American Legion, Dayton Engineers' Club, Phi Lambda Upsilon, Sigma Xi, and Civitan International—Service Club.

Annual Meeting (continued)

Notes on Some of the More Important Committee Actions and Recommendations as Effected at the Meeting

Reports on Ferrous Metals

In addition to numerous recommendations affecting its product specifications, Committee A-1 on Steel completed two new test procedures, one on tension testing of steel spring wire and the other on macroetch testing and inspection of steel forging, billet material, etc. Macroetch testing is described as a method for examining sections of forgings or billets, blooms, etc., for the detection of such defects as bursts, pipe, excessive segregation, flakes, etc. The procedure employs the action of an acid or other corrosive agent to develop the characteristics of a suitably prepared specimen. The name implies that the etched surface is examined visually, or only at very low magnification.

Important revisions clarifying the section on finish of pipes for use at high temperature were accepted and a number of desirable changes of the requirements for structural quality sheets (A 245, A 246) were approved. Most important changes in the specifications for high-temperature pipe flanges, etc. (A 182), involved complete overhauling of the numerous alloy grades covered and the addition of several types coming into use.

Committee A-3 on Cast Iron had approved its new tentative Specification for Gray Iron Castings for Non-Pressure Containing Parts at Elevated Temperatures (A 319). The committee also

recommended for immediate adoption a revision of the Specification for Gray Iron Castings (A 48) which designates the tension test as the primary test for qualification but provides that by agreement between the manufacturer and the purchaser, the tension test may be waived and the transverse test may be specified.

The changes recommended by Committee A-5 on Corrosion of Iron and Steel in the Specifications for Zinc-Coated Farm-Field Fencing (A 116) and Barbed Wire (A 121) bring them into agreement with the Department of Commerce Simplified Practice Recommendation R9-47. Numerous changes were also recommended in the Specification for Zinc-Coated (Galvanized) Iron or Steel Sheets (A 93), the specification being reverted to tentative.

The committee also reported that the test site at Key West, Fla., was relocated during the early part of 1948 due to the development of this site into a bathing beach by the City of Key West. The new site is located at the U. S. Navy Submarine Base. The 1948 report of the committee also carries detailed reports from the subcommittees in charge of inspection of black and galvanized sheets, of field tests of wire and wire products, and of hardware.

The June meeting of Committee A-6 on Magnetic Properties marked the retirement from active duty as chairman of Mr. Thomas Spooner of the Westinghouse Electric Corp. who had served in this capacity since 1925 and who had been associated with the work of the committee well over a quarter of a century. The members of the committee tendered him a testimonial dinner at which there was presented to him a watch which, much to his astonishment, bore engraved upon it a facsimile of his own signature. The meeting also marked the retirement from active duty on the committee of Dr. P. H. Dike of Leeds and Northrup Co., Philadelphia, who had been vice-chairman of the committee since that office was established in 1936. (A list of the officers (new and hold-overs) of all technical committees is elsewhere in this BULLETIN.)

During the Annual Meeting the committee sponsored a Symposium on Magnetic Testing and Properties at which nine very interesting papers were presented during the morning and afternoon sessions. The committee also presented to the Society for immediate adoption several revisions in the Standard Methods for Testing Magnetic Materials (A 34) and in the Standard Definitions of Terms, with Symbols, Relating to Magnetic Testing (A 127). At the meeting, W. J. Morris presented some interesting results of aging tests at temperatures of 100, 150, 200, and 250 C. He explained that he considered these to be only preliminary results but thought that they might be published in the A.S.T.M. BULLETIN. It was agreed that this would be desirable.

There was some discussion of the values of core loss at 15 kilogausses recently published by the American Iron and Steel Institute. While these values are expected to give about the same results as tests at 10 kilogausses, the opinion was expressed that the values are probably too high but it would take some time to accumulate enough experience to make a proper revision of the manual figures.

Committee A-7 on Malleable Iron Castings completed revisions in the Specifications for Pearlitic Malleable Iron Castings (A 220) and for Malleable Iron Castings (A 47). These clarify the sampling and testing requirements for malleable iron made by the multiplex process, as the specifications, while recognizing the multiplex process for manufacture, had not adequately provided for this in the sections on sampling and testing. These requirements were worked out in cooperation with a representative group of the American Association of Railroads.

Since the last report of Committee A-9 on Ferro-Alloys, which had been reactivated after a period of relative inactivity during the war, jurisdiction over the Tentative Method for Sampling Molybdenum Salts and Compounds for Metallurgical Use (E 66–34 T) had been transferred from Committee E-3 on Chemical Analysis of Metals back to Committee A-9 which had originally written this method under the designation A 156. The committee's seven standards for ferro-alloys were reaffirmed for continuation as standard without change.

Committee A-10 reported that discussion had brought out the need for a more complete understanding of the fundamental nature of stress corrosion and stress-corrosion cracking, not only of the corrosion-resistant steels but of other metals. As a consequence, this subject was brought to the attention of the Advisory Committee on Corrosion and, subsequently, to the Administrative Committee on Research, both of which committees had endorsed the project. It was pointed out that the Office of Naval Research might be interested in supporting such a program and a preliminary, informal conference with O.N.R. having indicated that such was the case, the project has been formally brought to their attention by the Society.

The A.W.S.-A.S.T.M. Joint Committee on Filler Metal reported the conclusion of a very active year's work on specifications. The Specification for Iron and Steel Arc-Welding Electrodes (A 233) was completely revised and has been split into two specifications; one covering mild steel (A 233) and the other low alloy steel (A 316). The Specification for Corrosion-Resisting Chrome and Chromium Nickel Steel Welding Electrodes (A 296) has also been completely revised and four additional grades added. This and a new Specification for Copper and Copper Alloy Filler Metal (to which the designation B 225 will be assigned) are in the hands of the Administrative Committee on Standards for approval.

Non-Ferrous Metals

Committee B-1 on Wires for Electrical Conductors reported a very active and successful year of work, submitting to the Society eight new tentative specifications. Four of these related to aluminum conductors, three to conductors using copper-covered steel wire and the final one for cored annular concentric-lay stranded copper conductors. The committee also submitted a complete revision of the Method of Test for Resistivity (B 193) and minor revisions in two standards for copper conductors and recommended the adoption of another tentative for copper conductors as standard.

The committee also noted with deep regret the passing on April 17 of its secretary, E. H. Kendall, whose cheerful, unselfish, and unstinted service on behalf of the committee will be missed by all.

A revision of the sampling procedure in the Specifications for Slab Zinc (Spelter) (B 6), worked out in cooperation with Committee E-3 on Chemical Analysis of Metals was reported by Committee B-2 on Non-Ferrous Metals and Alloys.

The committee also noted with regret the retirement from active service of W. B. Price, former Director of Research Scovill Mfg. Co., who, as noted elsewhere in the BULLETIN, was awarded Honorary Membership in the Society.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys presented with its annual report new data collected by its Subcommittee VIII on Galvanic and Electrolytic Corrosion. This covered atmospheric exposure tests started in 1941 to determine the corrosion behavior of various metals and alloys when coupled with stainless steels and exposed to typical atmospheres. Four test locations were used and nine other metals were each coupled with two types of stainless steel.

Also appended to the B-3 report was a paper on "Apparatus and Factors in Salt Fog Testing" by V. M. Darsey and W. R. Cavanagh of the Parker Rust-Proof Co.

Committee B-4 on Electrical Heating, Resistance, and Related Alloys recommended a new Tentative Method of Test for the Modulus of Elasticity of Thermostat Metals (Cantilever Method). It also proposed extensive revisions in two standard tests which were reverted to tentative, covering Resistivity of Metallic Materials (B 63) and Sleeves and Tubing for Radio Cathodes (B 128).

The cooperative investigation being carried on by Section A of Subcommittee VIII on the emissivity of cathode nickel has continued at a high rate of activity. Abstracts of several papers describing some of this work were published in the May BULLETIN.

Committee B-5 on Copper and Copper Alloys, Cast and Wrought had a large number of recommendations on its numerous standards and tentatives, all of which were detailed in its report. The committee also reported the redesignation of its subcommittees using the symbols W-1, F-1 and G-1, etc., in place of A-1, B-1 and C-1, etc., to avoid confusion

with the main committees of the Society. This committee, as well as Committees B-1 and B-2, reported the publication of a Tentative Classification of Copper (B 224–48 T) which had been prepared jointly by the three committees. This is a long-needed development on which the committees had been working for a number of years.

Committee B-6 on Die-Cast Metals and Alloys recommended to the Society revisions in the Tentative Specifications for Aluminum-Base (B 85), Magnesium-Base (B94), and Copper-Base Alloy Die Castings (B 176). In the case of the aluminum-base and the copper-base, these revisions each included the addition of a new alloy. The committee also recommended for immediate adoption revisions in the Standard Specifications for Zinc-Base Alloy Die Castings (B 86–46) and for Lead- and Tin-Base Alloy Die Castings B (102).

The revisions in 11 specifications, as perfected during the year by Committee B-7 on Light Metals and Alloys complete a very large part of the program initiated by the committee immediately following the war to revise their specifications and to increase the coverage in the field of light metal alloys. It is hoped that before the end of the year all the B-7 Specifications and some of the Committee B-1 Specifications applying to aluminum conductor will be collected and published in a separate compilation.

Committee B-9 on Metal Powders and Metal Powder Products recommended for adoption four tentative methods of test relating to the apparent density (B 212); flow rate (B 213); sieve analysis (B 214), and sampling (B 215) of metal powders. Also reported was the completion of a list of definitions of terms relating to powder metallurgy which, after review by Committee E-8 on Nomenclature and Definitions, will be submitted to the Society for approval.

Cementitious, Concrete, Masonry and Related Constructional Materials

Recommendations presented by Committee C-1 on Cement included three methods for determination of titanium oxide in portland cements as part of the Method of Chemical Analysis (C 114). Specifications for portland cement are to be revised to include a change in the compressive and tensile strength requirements for Type V cement, thereby conforming to the same respective strengths required for Type III cement. An additional type, namely, Type III-A, will be added to the tentative Specification for Air-Entraining Portland Cement (C 175) which will include the same chemical and certain physical requirements as now used for Type III, normal Portland cement. The Specifications for Portland Blast-Furnace Slag Cement (C 205) will provide requirements for an air-entraining cement. Recommendation was made to adopt the tentative Specifications for Masonry Cement (C 91 T), and withdraw the present standard (C 91–40). A new definition for the term "addition" has been formulated.

Committee C-2 on Magnesium Oxychloride Cements in its first year of activity has shown great progress in formulating methods of tests, 9 proposed standard tests including such determinations as transverse and compressive strength, bulk density, sampling and analysis of magnesium chloride having been submitted to the Society for approval. Seven additional methods are in process of letter ballot and other methods are being studied.

Six of the seven subcommittees of Committee C-7 on Lime met with very good attendance. During the year a poll of all members was taken in respect to all A.S.T.M. tenatives and standards under the jurisdiction of the committee to determine the need for their review or revision. Tentative specifications for both normal and special finishing hydrated lime (C 6) and (C 206), respectively, will be submitted to letter ballot for advancement to standard along with the Tentative Specifications for Hydrated Lime for Masonry Purposes (C 207) and Tentative Methods of Physical Testing of Quick Lime and Hydrated Lime (C 110).

Committee C-9 on Concrete and Concrete Aggregates noted good progress in its activities during the first year of operation under the streamlined group plan. Many projects are under way within both the research and the specifications and test methods subcommittees.

The Specifications for Ready-Mixed Concrete (C 94) are being recommended for advancement to standard without revision. A revised definition of the term "admixture" has been presented for inclusion in the list of terms relating to concrete and concrete aggregates (C 125) now recommended for advancement to standard. Two revisions of standards for immediate adoption involve the Test for Organic Impurities in Sands for Concrete (C 40) whereby the alternate method for color value using the color plate is deleted, and the Test for Material Finer than No. 200 Sieve in Aggregates (C 117) in which a revised description of the two sieves will avoid confusion.

The tentative Definitions of Terms Relating to Gypsum (C 11 T) are to be advanced to standard and incorporated in the existing standard. Committee C-11 on Gypsum also recommended a significant *tentative* revision of the Specifications for Gypsum Plasters (C 28) which eventually would change the strength requirements from tensile to dry compressive strength thus raising the minimum strength substantially over the previous limits, either tensile or compressive. Two standard specifications were withdrawn, covering Calcined Gypsum for Dental Plasters (C 72) and Gypsum Pottery Plaster (C 60).

The principal recommendation of Committee C-12 was a new tentative specification for mortar for unit masonry. The feature of this new specification is that it contains both property requirements and proportion requirements with each set up as an alternate to the other. If this new specification is found acceptable it will eventually replace the existing tentative specification for mortar for reinforced brick masonry (C 116).

Committee C-15 on Manufactured Masonry Units held well-attended meetings of six of its subcommittees and the main committee. Changes in the Specification for Clay Building Brick (C 62) involve the section on size and additional requirements in respect to appearance and size are to be adopted. Included in the activities was the initial meeting of the new subcommittee on chemical resistant brick. An interesting feature of the main meeting was the presentation of a traveling bag to the retiring chairman, D. E. Parsons.

The activity of Committee D-4 on Road and Paving Materials is reflected in part by the completion of several new tentative specifications of a comprehensive nature including requirements for asphaltic mix for sheet asphaltic pavements, specifications for emulsified asphalt and methods for sampling bituminous paving mixtures. The emulsified asphalt, document represents the consolidation of five existing specifications without modification of technical requirements, and it is anticipated that when adopted as standard, it will replace the existing specifications. Proposed specifications for bituminous paving plant requirements and for bituminous expansion joint fillers for concrete are being circulated for letter ballot. Tentative definitions have been prepared for the terms bituminous material, bituminus emulsion, cut-back products, asphalt, rock asphalt, water-gas-tar and dehydrated tar.

Committee D-6 on Paper and Paper Products presented eight new tentative test methods for publication covering the determination of the reducible sulfur in paper; analytical filter papers; stretch of paper and paper products under tension; organic nitrogen in paper and paperboard; measuring paraffin wax absorptiveness of paper; 45 degree, 0 degree directional reflectance for blue light (brightness) of paper; preparation of a magnesium-oxide standard for spectral reflectivity; water-vapor permeability of paper, paperboard, and other sheet materials, the latter representing a consolidation and replacement of Tentative Methods D 783 and D 830. The proposed method of wax pick test for surface strength of paper is presented for information to solicit comments before publication as an A.S.T.M. standard. Specifications for filter paper for chemical analysis are being drafted and several test methods for determining proper requirements for paper and fiber board are in process.

While Committee D-8 on Bituminous Waterproofing and Roofing Materials presented no recommendations at the meeting, there has been much activity. Nine subcommittees held meetings, including the new subcommittee on compatibility of bituminous materials. More information on the several projects now under way will be found in a later article

Presentation of Thompson Award to W. C. Hanna,

by Sanford E. Thompson[1]

For many years, occasional concrete structures have developed expansion and cracks, the cause of which could not be determined by usual means. The cement and the aggregates, both fine and coarse, had passed all standard tests. Yet the concrete, sometimes after several years in place, was sadly defective.

The author of this paper, "Unfavorable Chemical Reactions of Aggregates in Concrete and a Suggested Corrective," for which the Award is given this year, had observed every once in a while, through a period of many years, structures with the characteristics of expansion and cracking.

As Chief Chemist and Chemical Engineer of the California Portland Cement Co. of Colton, Calif., he instituted tests of samples of concrete from defective structures. He searched out aggregates corresponding to those used in the defective concrete. He had carried on such tests for more than ten years.

He found that the trouble evidently arose with the presence in the concrete of small pockets of gelatinous material of alkaline composition. Only special tests of the aggregate, which is most often the sand, would show its defect.

The problem then was to determine the best method of making the concrete so as to correct the effect of the reactive aggregate. His exhaustive tests show that this correction was best made, in cases where the reactive aggregate had to be used, with the use of correct pozzolana. These tests and those by other experimenters who contributed to the discussion of this paper show that the pozzolana might be required up to 15 per cent or even 30 per cent of the weight of the cement. The pozzolana was added either to the cement as it was ground or as an admixture to the concrete as it was being placed.

The earliest structure, above ground, of portland cement concrete was built about 1886. In that day the portland cement, usually from England or Germany, was tested neat in briquets as in the present day. All hard aggregates were assumed to be inert. Sand was tested by placing a little of it in the palm of the hand and rubbing it. If it was sharp and the skin was not discolored, the sand was accepted as satisfactory. And if any trouble was found in the concrete, it was invariably laid to the cement and the poor cement manufacturer had to pay the bill.

Later, about 1913, the cause of poor concrete, in many cases, was found to be organic matter in the sand. At the same time the importance of scientific grading of the aggregates was appreciated and A.S.T.M. Committee C-9 was formed for the prime purpose of investigating these qualities and determining the best methods of testing. One rather interesting point was discovered at that time through a series of tests. One brand of cement from one mill prevented deterioration of concrete made with impure sand. This particular point, however, was never investigated because it is comparatively easy to wash sand or to substitute sand from a good pit.

Since that early date, researches of Committee C-9 and other A.S.T.M. committees have marvelously extended a knowledge of concrete and its ingredients. The present paper on reactive aggregates has added to the information.

The objective of researches such as have been made by the author of this paper is to formulate, eventually, specifications which will guide the builders of concrete structures to obtain most permanent results with the maximum economy in cost of materials and labor.

We, as members of the Society, are so close to its multitudinous operations through its committees and subcommittees that we often fail to appreciate the really marvelous accomplishments in practice that have been made through the utilization in construction of the standards developed for selection of materials and their method of use. Safety and permanence are the qualities about which we think most, but the cost reduction in construction work through following specifications which avoid excessive volume of material amounts to many millions of dollars, probably billions.

The author of the paper before us well merits recognition not only for the compilation of the paper itself, but for his work as a Chemical Engineer and particularly his work as a member of A.S.T.M. Committees. A member of Committee C-9 on Concrete and Concrete Aggregates about 15 years, he has served on C-7 on Lime about 30 years; on C-1 on Cement about 20 years; and on C-12 on Mortars for Unit Masonry for many years. He has served as Chairman of the C-9 Subcommittee on Chemical Reactions of Aggregate in Concrete since its organization; chairman of Committee on Methods of Chemical Analysis, of Committee C-1; and a member of the Board of Directors of A.S.T.M. from 1944 to 1947.

[1] President, The Thompson & Lichtner Co., Inc.

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in this issue. The committee along with Committee D-4 is interested in the development of the symposium on accelerated durability tests for bituminous materials for presentation at the 1949 Annual Meeting.

In Committee D-18 on Soils for Engineering Purposes most of the activity has been concentrated in the establishment of their new organization based on groups of small research and standards subcommittees. These research subcommittees have now consolidated their organization and a variety of research programs have been established which are outlined in another part of this issue. Two interesting papers were presented at the main meeting of the committee. These papers were, "The Importance of Relative Density in Studying the Behavior Characteristics of Soils," by D. M. Burmister, and "The Determination of Limits for the Control of Placement Moisture in High Rolled Earth Dams," by W. G. Holtz.

Miscellaneous Materials and Subjects

The activity of Committee D-1 on Paint, Varnish, Lacquer, and Related Products is indicated by the 55 meetings of its subcommittees and sections which were held during the Annual Meeting. This committee presented an extensive report which included many recommendations on standards. At the conclusion of the business meeting, the following papers were presented: "A New Color Difference Meter"—I. Design and Theory, Richard S. Hunter, Henry A. Gardner Laboratory; II. Some Applications to Paints, Francis Scofield, National Paint, Varnish, and Lacquer Assn., Inc.; "The Concept of Organic Coating Hardness," Marshall H. Switzer, Consulting Food Technologists and Associates.

Committee D-1 submitted a number of new specifications for pigments and also revised several of the present pigment specifications to bring them up to date. The new items cover copper phthalocyanine blue, copper powder for antifouling paints, para red and toluidene red pigments, and aluminum powder and paste for paints.

New specifications were approved for raw castor oil, dehydrated castor oil, heavy mineral spirits, and secondary butyl acetate. An important contribution was a new abrasion test for coatings of paint, varnish, and lacquer by the falling sand method. In addition, there was a revised test for specular gloss of paint finishes, also revised methods of chemical analysis of zinc yellow pigments, revised specifications for wood panels used in weathering tests, and a revised test for acetone extract in black pigments.

Committee D-2 on Petroleum Products and Lubricants continued its intense activity, with 52 meetings held over a period of six days. The extensive work done by this committee during the past year is also indicated by its report—the largest presented at the Annual Meeting.

The Symposium on Industrial Gear Oils, sponsored by Technical Committee B on Lubricating Oils, with eight papers, was held on Tuesday afternoon. There was a large attendance at this meeting. The Society is planning to make these papers available in a separate publication.

Among the large number of standards recommendations presented were new specifications for three grades of diesel fuel oils suitable for various types of diesel engines. A new grade 115–145 aviation gasoline was added to Tentative Specifications D 910. An appendix was added to the specifications for motor gasoline (D 439) which discusses the significance of A.S.T.M. specifications for this product. The Method for Interfacial Tension of Mineral Oil Against Water by the Ring Method was accepted as tenta-

tive. This test gives a reliable indication of the presence of hydrophilic compounds. A new Tentative Method for Neutralization Value by Color Indicator was presented, also a revision of the test for tetraethyllead in gasoline.

An important addition to the report was a revision for immediate adoption in the Standard Method of Test for Knock Characteristics of Motor Fuels by the Motor Method (D 357), which comprised the use of the detonation meter as optional equipment to the bouncing pin and the inclusion of a revised section for reproducibility.

There were five methods accepted for publication as information. These cover tests for performance characteristics of wheel bearing grease, separation of residue from butadiene, test for dimer content of butadiene, and for nonvolatile residue of butadiene, and test for sulfur in petroleum oils by quartz tube combustion. Also, proposed factors and tables for volume correction and specific gravity conversion of liquefied petroleum gases were accepted for publication as information.

Committee D-3 on Gaseous Fuels recommended the revision and adoption as standard of the Tentative Method of Test for Calorific Value of Gaseous Fuels by the Water-Flow Calorimeter (D 900). The revision covers changes in the specifications for calorimeter and flue thermometers, the addition of directions for reducing results to the basis of field measurements of gas, and the addition of a reference to more complete information regarding the derivation of a humidity correction formula.

Committee D-3 has in preparation a method for analysis of natural gas using the mass spectrometer. It also has prepared for study, methods for analysis of carbureted water gas and natural gas by chemical-volumetric methods. Draft of a proposed method for specific gravity of gaseous fuels is under study, as is also a proposed method for measuring gaseous fuel samples. Action on these several matters is expected to be taken at the next meeting of Committee D-3 which will be held in Atlantic City in October, just preceding the annual meeting of the American Gas Association.

Committee D-5 on Coal and Coke presented a new tentative method of sampling and analysis of coal for volatile matter determination in connection with smoke ordinances. This method is applicable to the sampling of relatively small quantities of coal as delivered to apartment buildings, hotels, laundries, domestic consumers, etc., where it is impractical to collect large gross samples.

Revisions were presented for immediate adoption in the riffle samplers used in the laboratory sampling and analysis of coal and coke (D 271) and in the sampling of coals classed according to ash content (D 492). A revised drawing showing the shatter test machine was also accepted for inclusion in the shatter test for coke (D 141) and for coal (D 440). A paper describing research on a laboratory method of testing the reactivity of solid fuels to oxidizing gases was presented at the Annual Meeting by Jonakin, Cohen, Corey, and Jain entitled "Reactivity of Solid Fuels by the Crossing Point Method."

Committee D-9 on Electrical Insulating Materials held a three-day series of meetings at which considerable progress was made on a number of projects. The committee presented a very important revision of the test for high-voltage low-current arc resistance of solid electrical insulating materials. A test for detection of free sulfur in electrical insulating oils was also presented as tentative. The committee withdrew from its report a recommendation for adoption as standard of the Tentative Method of Test for Dielectric Strength of Insulating Oil of Petroleum Origin (D 877–46 T). It also joined with Committee D-20 in withdrawing the revision of the Tentative Specifications for Nonrigid Vinyl Chloride Plastics (D 744–44 T).

Committee D-11 on Rubber Products held meetings over three days and completed several matters which will be presented to the Society through the Administrative Committee on Standards. These include new tentative specifications for thermoplastic vinyl polymer sheaths for electrical insulated cords and cables. Also the new Subcommittee on Rubber Latices reached agreement on proposed specifications and methods of test for concentrated ammonia-preserved, creamed and centrifuged natural rubber latex. These specifications are very timely and are needed because of the large number of new producers of latex, particularly natives in the Far East who have entered this field of production since the war. The proposed specifications, to be published as information, will indicate a level of quality for such materials.

A proposed method of measuring low-temperature stiffening of rubber and rubber-like materials by the Gehman torsion apparatus was accepted for publication as information. The Subcommittee on Low Temperature Tests is studying some further changes in this method.

The Subcommittee on Life Tests has planned a symposium on life aging of rubber which will be held at the next meeting of the committee. The Subcommittee on Tests for Coated Fabrics is continuing its study of various abrasion machines. It has undertaken some tests on the abrasion apparatus developed by Dr. Schiefer of the National Bureau of Standards and it is also continuing its study of the Taber Abraser and the American Seating Co. apparatus. The committee withdrew from its report the recommended revision in the Tentative Specifications for Insulated Wire and Cable: Class AO, 30 per cent Hevea Rubber Compound (D 27–46 T). It is planned to submit this revision at a later date through the Standards Committee.

The technical Committee on Automotive Rubber, which functions jointly under the auspices of A.S.T.M. and the Society of Automotive Engineers, also met in connection with Committee D-11. The new tentative method of test for volume resistivity of electrically conductive rubber and rubber-like materials was prepared by this committee. New tentative specifications for gaskets which cover a number of types made from a variety of materials were presented to Committee D-11 as tentative, subject to favorable letter ballot. Methods of testing V-belts were approved for submission to letter ballot. A revision of the test for contact and migration stain of vulcanized rubber in contact with organic finishes (D 925) is being studied.

Committee D-12 on Soaps and other Detergents presented a new tentative method for sampling and chemical analysis of borax (D 501–48 T). The tentative definitions (D 459) and the tentative revisions of the specifications for chip soap (D 690), for milled toilet soap (D 455), and for floating toilet soap (D 499) were recommended for adoption as standard. Several sections in methods of sampling and chemical analysis of soaps and soap products (D 460) were editorially revised to correct and clarify.

The most important recommendation in the report of Committee D-13 on Textile Materials was a revision of the definition of rayon. The change recognizes the cellulose ester fibers as having properties of a physical and chemical character sufficiently different from those of the regenerative cellulose fibers to warrant their classification under a new generic term "estron." A definition of the term "estron" was also accepted as tentative. In addition definitions were presented covering some eight new terms and revisions of about nine existing definitions.

An important addition made to the Test for Apparent Fluidity of Dispersions of Cellulose Fibers (D 539–40 T) covers a new Method B for dispersions in cupriethylene diamine hydroxide. Revisions were also accepted in the specifications for asbestos yarns (D 299) and for woven cotton tapes for electrical purposes (D335), and for jute rove and plied yarn for electrical and packing purposes (D 681). In addition, revisions were made in the specifications for woolen yarns (D 403) and worsted yarns (D 404). A very important contribution was the tentative recommended practice for planning interlaboratory testing of textile materials. These recommendations are of a general nature and may be found suitable for use by other technical committees of the Society. Further work on this subject is also under way in Committee E-11 on Quality Control of Materials.

Committee D-17 on Naval Stores presented for adoption as standard, definitions of terms relating to naval stores and related products (D 804) and also the methods of sampling and testing dipentene (D 801).

At its meeting the committee reviewed the status of a number of projects that are under study. It is cooperating with Committee E-1 on Methods of Testing in combining the two present ring-and-ball softening point methods. The committee has compiled an outline of various softening point methods which it is expected will be published later in the year.

This collection of information is expected to be very helpful to those interested in softening point determinations. The committee is studying methods of determining volatile oils in rosin, also procedures for unsaponifiable matter, ash, and iron content of rosin. Studies of tall oil include the applicability of electrometric titration methods for determining rosin acid number of crude tall oil. A further study of terpene alcohol determination for testing pine oil is being made. Additional tests for turpentine covering procedures for determining acidity (resin acid content) and evaporation residue are also being studied.

Committee D-19 on Industrial Water sponsored the panel discussion on the influence of Non-Ferrous Metals and Their Compounds on the Corrosion of Pressure Vessels.

It completed two new tentative methods of test—one for the nitrate ion and the second for sulfate-reducing bacteria in industrial water. The committee also submitted revisions in the Recommended Practice for Field Sampling of Water-Formed Deposits (D 887), the Method of Test for Total Aluminum and Aluminum Ion in Industrial Waters (D 857), and The Embrittlement Test (D 807). The Method for Determination of Total Carbon Dioxide and Calculation of the Carbonate and Bicarbonate Ions in Industrial Waters (D 513) was completely revised.

The committee as noted elsewhere in the BULLETIN, also reported the establishment of a new Subcommittee VII on Water-Borne Industrial Wastes.

Committee D-20 on Plastics recommended the adoption as standard of five tentative methods and also presented revisions in four specifications for plastics and in the test for stiffness in flexure and the recommended practice for molding specimens of phenolic materials. An important revision in the Rockwell hardness tests which covers a new alpha scale was accepted subject to concurrence of Committee D-9. The committee withdrew from its report the proposed revision of the definition of the noun "plastic" and also the proposed revision of the Tentative Specifications for Non-Rigid Vinyl Chloride Plastics (D 744–44 T).

At the conclusion of its meeting the committee held an interesting exhibit of special apparatus and equipment used by its members in studying and evaluating plastics.

"E" Committees

Committee E-1 on Methods of Testing reported that its various technical committees and sections had reviewed during the year and just prior to the Annual Meeting a number of new and revised Methods prepared by other Society committees.

The Section on Pigment Type Materials through its Task Group on Optical Microscope completed a new proposed tentative method of analysis by microscopic methods for the particle size distribution of particulate substances of subsieve sizes. This method, a revision of the Tentative E 20, will be submitted to the Society during the summer.

The Section on Thermometers completed the following specifications for new thermometers which will also be presented as tentative through the Standards Committee:

A.S.T.M. Tank Low Thermometer
A.S.T.M. Tank Medium Thermometer
A.S.T.M. Tank High Thermometer
A.S.T.M. Bomb Calorimeter Thermometer
A.S.T.M. Tag Closed Tester Thermometer, Low Range

Committee E-1 has received a recommendation from its Technical Committee X on Conditioning and Weathering for a revision of the Tentative Definitions with Procedures Relating to Conditioning and Weathering (E 41–42 T). The revision provides for changing the conditions for the standard laboratory atmosphere to that having a relative humidity of 50 ± 2 per cent at a temperature of 23 ± 1.1 C. (73.4 ± 2 F.). After approval by letter ballot in Committee E-1 this recommendation will be offered to the Society.

The Section on Softening Point has prepared a proposed tentative method of testing softening point by the shouldered ring-and-ball apparatus. This represents a consolidation of Standard D 36, originally prepared by Committee D-4 on Road and Paving Materials, and Tentative Method E 28 developed under Committee E-1. Certain features of this proposed consolidated method are now being studied by the interested technical committees and it is hoped that agreement may be reached on a single method in time for presentation to the Society in 1949.

Committee E-8 on Nomenclature and Definitions presented a progress report which indicated that its work was being reactivated. It has recently reviewed an extensive set of definitions of terms relating to powder metallurgy prepared by Committee B-9. Various changes and suggestions were being discussed with this committee prior to presenting the definitions to the Society as tentative. The committee also reviewed the proposed revision of the definition of the term "slate" recommended by Committee C-18 and has approved this revised definition with, however, certain suggested changes. The committee has under review an extensive set of proposed definitions of terms pertaining to shipping containers and related items prepared by Committee D-10.

Committee E-3 on Chemical Analysis of Metals recommended for adoption as standard without revision the tentative methods for chemical analysis of metallic materials for electrical heating (E 38), copper (E 53), and for sampling wrought non-ferrous metals and alloys (E 55), and slab zinc (E 65). The committee also recommended for adoption the recommended practices for apparatus and reagents for chemical analysis of metals (E 50). During the past year a method for the determination of boron in steel (E 30–48 T) was accepted by the Administrative Committee on Standards.

Committee E-2 on spectrographic analysis reviewed the progress in the compiling of suggested methods for spectrographic analysis of metals. Thirty-five such suggested methods have been received by the committee to date.

Committee E-9 on Fatigue reported that during the last year most of the activity of the committee had been directed toward the preparation of a Manual on Fatigue Testing. The manuscript which had been prepared for the eight sections of this Manual now comprises a total of 167 pages, the review of of which has almost been completed.

While this year, Committee E-9 did not specifically sponsor any sessions on fatigue at the Annual Meeting, there were nine papers presented at the Tenth and Eleventh Sessions, all of which were reviewed by the committee, which also took great pride in the fact that the Dudley Award this year was for a paper on fatigue presented at the 1947 Annual Meeting.

40-Year Members

CONTINUING the policy of recognizing those members who have been affiliated with the Society for 40 years there were awarded to 23 companies and individuals certificates testifying to their four decades of membership in the Society. Including those recognized this year, the total 40-year membership now has reached the 138 mark. The 1948 list follows:

H. Austill
Brown University, Division of Engineering
Allan W. Carpenter*
Columbia Steel and Shafting Co.
Crane Co.
Roland P. Davis
Harold S. Falk
Henry A. Gardner
General Electric Co.
Prevost Hubbard
International Paper Co.
Albert J. Loepsinger
Frank M. Masters
Lesley McCreath*
Charles E. Paul
Pecora Paint Co.
Alfred P. Poorman
Purdue University Library
Joseph T. Ryerson & Son, Inc.
H. H. Scofield
Union Drawn Steel Division, Republic Steel Corp.
United States Pipe and Foundry Co.
Alan Wood, 3d

* Deceased, May, 1948.

Three Honorary Memberships Awarded

Messrs. H. L. Curtis, F. H. Jackson, W. M. Price Honored

IN RECOGNITION of their meritorious services to the Society over long periods of time and their eminence in the field of work in which the Society is engaged, three long-time A.S.T.M. members were awarded Honorary Memberships during the 1948 Annual Meeting. These three men—Harvey Lincoln Curtis, Frank H. Jackson, and William B. Price—are outstanding authorities in their respective fields and it was considered most fitting that they should receive the highest honor which the Society bestows.

President T. A. Boyd gave Messrs. Curtis and Jackson their membership certificates following brief citations given by Executive Secretary Warwick. Mr. Price who was unable to be present at the meeting but whose citation was given, expressed by letter his deep appreciation of the honor, and the two men present responded appropriately at the dinner. Biographical information on these three new Honorary Members follows.

F. H. Jackson

W. B. Price

H. L. Curtis

Harvey Lincoln Curtis

HARVEY LINCOLN CURTIS, for many years Principal Physicist and Chief, Inductance and Capacitance Section, Electrical Div., National Bureau of Standards, now retired, was born near Mason, Mich., and educated in elementary schools in that vicinity, receiving his Ph.B. degree from the University of Michigan in 1900, and his Ph.D. in 1910. Instructor in physics and elementary engineering at Michigan Agricultural College until 1907, he became affiliated with the Bureau of Standards in that year and served through 1946, now being consulting physicist.

A member of A.S.T.M. since 1923, he has been particularly active in the Society work involving electrical insulating materials, having been a member of Committee D-9 for many years and its Chairman from 1930–1934, and serving on at least ten of its subcommittees. He rendered notable service on the Administrative Committee on Standards from 1933 to 1939, and has been active in other A.S.T.M. projects including Committee B-4 on Electrical Heating, Resistance and Related Alloys, on which he has held membership since 1925. He has been active in and chairman of several of the subcommittees of Committee B-4, and is now an honorary member of that group.

The author of one text and of many papers and reports, he directed a group of scientists which developed methods for measuring in cannon, as a function of time, powder pressure, temperature of powder gases and velocity and acceleration of a projectile.

In addition to A.S.T.M. he is affiliated with the following organizations: American Institute of Electrical Engineers (Fellow), American Physical Society, American Association for the Advancement of Science, Optical Society of America, Washington Academy of Sciences, and Washington Philosophical Society.

Mr. Curtis' Washington address is National Bureau of Standards, 204 Electronics Bldg., Washington 25, D. C.

Frank H. Jackson

FRANK H. JACKSON, Principal Engineer of Tests, Public Roads Administration, Washington, D. C., is a native of the District of Columbia. Following studies at Ohio State University, he was in 1905 appointed to the U. S. Office of Public Roads, and he has been successively Assistant Engineer of Tests, Engineer of Tests, Senior Engineer of Tests, the latter since 1928, and more recently in his present position. He was in direct charge of the nonbituminous road materials laboratory of the Bureau from 1915 to 1924, and in general charge of nonbituminous road materials investigation, including concrete, since 1924.

Mr. Jackson joined the Society in 1916 and has been active in the work of a number of its committees, including Committee C-1 on Cement, Committee C-9 on Concrete and Concrete Aggregates, Committee C-15 on Manufactured Masonry Units, and Committee D-4 on Road and Paving Materials. He was Secretary of Committee C-1 from 1926 to 1931, and is at present Chairman of that important committee, having been elected in 1945. He was also Chairman of Committee C-9 for the period 1938 to 1944. A member of the Executive Committee of the Society in 1930, he also rendered notable service to A.S.T.M. as a member of its Administrative Committee on Standards from 1941 to 1947.

In addition to the Society, Mr. Jackson is also affiliated with the American Concrete Institute, of which he is a former director, and now vice-president, and the American Association of State Highway Officials. He served as Secretary of the Committee on Materials of the latter organization for a number of years. He also has been Chairman of the Technical Committee on Road and Paving Materials, Federal Specifications Board.

Mr. Jackson is the author of a number of papers and reports dealing with the properties of and the methods of testing portland cement concrete, concrete aggregates, and related materials, many of which papers appear in the A.S.T.M. *Proceedings*.

Mr. Jackson's Washington address is Public Roads Administration, Federal Works Agency, Washington 25, D. C.

William B. Price

WILLIAM B. PRICE, retired late in 1947, was for many years Chief Chemist and Metallurgist, Scovill Manufacturing Co., Waterbury, Conn. He had been connected with the company since his graduation from Sheffield Scientific School of Yale University in 1902, where he received honors in chemistry. Thus he had been employed by one company for some 45 years.

A pioneer metallurgist in the brass industry, he has done a great deal to place the industry on a sound scientific and technical basis. In 1911 he wrote the well-known book covering "Technical Analysis of Brass."

A member of the Society since 1913, Mr. Price has taken a very active part in numerous phases of the Society's technical work, particularly in the non-ferrous fields. He has been a member for many years of Committees B-2 on Non-Ferrous Metals and Alloys, B-3 on Corrosion of Non-Ferrous Metal and Alloys, B-5 on Copper and Copper Alloys, Cast and Wrought, D-2 on Petroleum Products and Lubricants, and E-4 on Metallography. A former member of the Executive Committee of the Society.

he has participated in a wide range of A.S.T.M. activities.

Mr. Price has been a leading figure in the field of standardizing methods of chemical analyses of copper and zinc. The methods for the battery assay of copper and the analysis of spelter which he was primarily responsible for developing were approved first by the American Chemical Society and later by A.S.T.M. in 1919.

He has prepared a large number of technical papers and reports which have appeared in scientific, technical, and business journals, many having appeared in A.S.T.M. publications. He holds patents on a number of alloys in the field of his interest.

Among the societies with which Mr. Price has been affiliated are the following: American Institute of Mining and Metallurgical Engineers, Society of Automotive Engineers, American Chemical Society, American Electrochemical Society, and Institute of Metals (British).

Mr. Price's home address is Box 534, Waterbury 85, Conn.

Testing Equipment and Apparatus on Display in Eighth Apparatus Exhibit; Many New Instruments Shown

A GREAT deal of unique and interesting equipment was displayed and demonstrated at the Eighth Exhibit of Testing Apparatus and Related Equipment held in connection with the Fifty-first Annual Meeting in Detroit. The close cooperation of the commercial exhibitors in planning interesting booth displays, as well as the interest and help of the Committee on Exhibits, headed by J. L. McCloud, Ford Motor Co., and also the participation of several A.S.T.M. technical committees, each with attractive arrangements demonstrating important features of their work, helped to make this exhibit one of the Society's finest.

The Exhibit has come to be considered a valuable adjunct of the Annual Meeting, showing as it does the range of reliable instruments which have always played an essential part in testing and evaluation of materials. The Society, through the work of its committees, has played an important part in making known the need for various instruments and aiding in their development.

The following list of committees and commercial exhibitors will give some idea of the fields which were covered in various ways in the Exhibit.

EXHIBITS OF A.S.T.M. TECHNICAL COMMITTEES:

C-2 on Magnesium Oxychloride Cements
D-7 on Wood
D-9 on Electrical Insulating Materials
E-4 on Metallography (Photographic Exhibit)
E-7 on Radiographic Testing (Photographic Exhibit)

The display of Committee D-7 consisted of a number of colorful photographs portraying some of the activities of Committee D-7 including specifications, tests, nomenclature, moisture content, and fire-retardant. Committee D-9 had a most interesting display of instruments, equipment, and informative panels covering three phases of the work of this committee: (*a*) Arc-Resistance Tests (D 495) (schematic diagram, identification of exhibits, old and new electrodes, polishing jig, etc.); (*b*) Instruments for Electrical Resistance of Insulating Materials (D 257) (informative panel, galvanometers, cross coil ohmmeter, potentiometer, bridge; (*c*) Specimens and Electrodes for Resistance Tests (D 257) (informative panel, mercury electrodes outfit—vertical and flat, mercury for these, desiccator set up with electrode leads, etc.).

Committee E-4 and E-7 sponsored sections in the Photographic Exhibit and there were a large number of photomicrographs, electron micrographs, etc., shown (a list of prize winners appears elsewhere in this BULLETIN) and Committee E-7 had a large number of very interesting radiographs, etc., which took a complete booth. There were so many radiographs that they were alternated from time to time in the viewing boxes.

The list of companies which took part in the commercial section of the Exhibit follows:

American Instrument Co., Inc.
Atlas Electric Devices Co., Inc.
The Baldwin Locomotive Works
Bausch & Lomb Optical Co.
Bowser, Inc.
Brookfield Engineering Laboratories, Inc.
Buehler, Ltd.
Burrell Technical Supply Co.
Carboloy Co., Inc.
Central Scientific Co.
Consolidated Engineering Corp.
Corning Glass Works
Detroit Testing Machine Co.
Harry W. Dietert Co.
Doble Engineering Co.
Eastman Kodak Co.
Eberbach & Son Co.
Gamma Scientific Co.
General Electric Co.
General Radio Co.
Hanovia Chemical and Manufacturing Co.
Illinois Testing Laboratories, Inc.
Jarrell-Ash Co.
Kewaunee Mfg. Co.
Kimble Glass Division of Owens-Illinois Glass Co.
King Refrigeration Co.
Laboratory Equipment Corp.
Lancaster Iron Works, Inc.
Leeds & Northrup Co.
Magnaflux Corp.
National Spectrographic Laboratories, Inc.
Tinius Olsen Testing Machine Co.
Parr Instrument Co.
Phipps & Bird, Inc.
Precision Scientific Co.
Rainhart Co.
Riehle Testing Machines Division of American Machine and Metals, Inc.
E. H. Sargent & Co.
Scott Testers, Inc.
Sperry Products, Inc.
C. J. Tagliabue Corp. (N. J.)
Waukesha Motor Co.
Wilson Mechanical Instrument Co.

The Exhibit was open two evenings during the week—Monday and Tuesday—with the official opening on Monday noon, and closing Friday noon. There was a good attendance at the Exhibit throughout the week, with visitors and members continually walking through the two exhibit rooms, this attendance indicating the intensive interest in the whole field of apparatus, instruments and laboratory supplies.

Interesting 1948 Photographic Exhibit

Radiographic and Photomicrographic Sections

ONE of the very interesting features of the Annual Meeting this year was the 1948 Photographic Exhibit, with sections on radiography and photomicrography. This was the sixth such exhibit, the last one having been held two years ago in Buffalo. Arranged under the auspices of a Detroit committee, headed by Frederick G. Weed, Rinshed Mason Co., the exhibit stressed the theme "Materials, Testing and Research." Representatives of Committees E-7 on Radiographic Testing and E-4 on Metallography cooperated closely with the local committee, these two groups being responsible for the Sections

on Radiography and Photomicrography. The personnel of the Photographic Committee follows:

Frederick G. Weed, *Chairman*, Rinshed Mason Co.
Robert C. McCleary, Chrysler Corp.
Don M. McCutcheon, Ford Motor Co.
Angelo R. Serratoni, Chrysler Corp.
J. Jean Vincent, Jr., Ethyl Corporation of America
Harry R. Wolf, General Motors Corp.

REPRESENTING COMMITTEE E-4 ON METALLOGRAPHY:

C. J. Tobin, General Motors Corp.
H. L. Shippy, Bausch & Lomb Optical Co.

REPRESENTING COMMITTEE E-7 ON RADIOGRAPHIC TESTING:

Don M. McCutcheon, Ford Motor Co.
E. W. Page, General Electric X-ray Corp.
H. E. Seemann, Eastman Kodak Co.
Kent R. Van Horn, Aluminum Company of America

Each member of the committee cooperated very closely and while the judging and hanging of the prints consumed considerable time, the mechanics of getting the exhibit together went off smoothly. Mr. Wolf kindly offered the facilities of his office for receiving and returning the prints which is always a laborious task, and particular mention might also be made of the efforts of Mr. McCutcheon who spark-plugged the nice exhibits arranged in a special booth for Committee E-7. Special viewing boxes were furnished by the Ford Motor Co., and with the installation of illuminating equipment from General Electric, excellent facilities were available for viewing the large number of radiographs that were submitted.

As has been noted previously, the Photographic Exhibit provides an excellent opportunity for members to see some of the oustanding work in this field. It stresses the importance and significance of good illustrations and the fact that they can be obtained, and also gives recognition for outstanding work along photographic and the other lines covered in the exhibit.

A list of the prize winners follows, the committee this year arranging the exhibits in the various classifications noted. It is planned to reproduce many of these prize-winning prints in issues of the ASTM BULLETIN.

GENERAL SECTION

Group I: Simulated Service Testing

First: *Simulated Service Test on Large Valves*, William W. C. Wilke, Jr., Crane Co. Research Laboratories
Second: *Shot Bag Static Test on Airplane Fuselage*, Herbert O. Jones, The Glenn L. Martin Co.
Third: *Simulated Service Test on Concrete*, Joseph B. James, Calcium Chloride Association

Group II: General Testing

First: *Devils Tea Cup . . .*, John Kalinich, Corning Glass Works
Second: *Progressive Wear of Tool Cutting Steel*, Harry T. Langdon, Pure Oil Co.
Third: *Paint Film Failure*, L. Boor, Bethesda, Md.
Honorable Mention: *Aging Cedar Shingles*, L. Boor, Bethesda, Md.
Honorable Mention: *Compression Test of Concrete*, Joseph B. James, Calcium Chloride Association

Group III: Testing Equipment

First: *Wash Bottles*, John Kalinich, Corning Glass Works.
Second: *Impact Testing*, William W. C. Wilke, Jr., Crane Co. Research Laboratories
Third: *Microhardness Testing*, William W. C. Wilke, Jr., Crane Co. Research Laboratories
Honorable Mention: *400,000 lb. Universal Testing Machine*, Lee Dougherty, The Glenn L. Martin Co.
Honorable Mention: *Vickers Hardness Test on Hot Metals*, William W. C. Wilke, Jr., Crane Co. Research Laboratories

Group IV: General Interest

First: *Glass Blower*, John Kalinich, Corning Glass Works
Second: *Blowing a Large Cylinder*, John Kalinich, Corning Glass Works
Third: *Stresscoat Cracks Indicate Temple Fracture from Blow at Position Shown*, H. R. Lissner and Dr. E. S. Gurdjian, Wayne University

Group V: Color Print

First: *Photoelastic Strain Pattern in Gear Teeth*, George R. Furman, The Texas Company

ELECTRON MICROGRAPH AND PHOTOMICROGRAPHS

Group I: Color Transparencies

First: *Hadfield Steel (As Cast), Bronze Overlay on Steel, Gray Cast Iron, Hadfield Steel (Polarized Light)*, F. Woodward, Rock Island Arsenal
Second: *Metallography in Color*, F. Gordon Foster, Bell Telephone Laboratories
Third: *Bearing and Friction Studies*, A. F. Underwood, Research Laboratories Div., General Motors Corp.

Group II: Electron Micrographs

A. Shadow Casting Techniques:

First: *Collagen Fibers*, M. C. Botty, American Cyanamid Research Laboratory
Second: *E Coli Destroyed*, M. C. Botty, American Cyanamid Research Laboratory
Third: *Polystyrene Emulsion*, E. Davis and E. J. Thomas, American Cyanamid Research Laboratory

B. Replica Technique:

First: *Optical and Electron Microscope Photographs of Pearlite*, William Pahl, Ford Motor Co.
Second: *Fracture of Polyacrylonitril*, F. G. Rowe and T. G. Rochow, American Cyanamid Research Laboratory

C. Particle Size Technique:

First: *Calcium Aluminate and Silica Gel*, E. Golovato and H. F. Mc-

"Devils Tea Cup..." First prize-winning photograph, General Section, General Testing Group, in the Sixth A.S.T.M. Photographic Exhibit, by John Kalinich, Corning Glass Works.

Murdie, National Bureau of Standards
Second: *Halloysite*, R. P. Humbert, Saratoga Laboratories, Inc.
Third: *Plant Life in Shale*, R. P. Humbert, Saratoga Laboratories, Inc.

Group III: Photomicrographs

A. Metals and Alloys

First: *Alnico V*, R. T. Knaggs, General Electric Co.
Second: *Faxfilm Replica of Lathe Chip*, T. Rice, Rock Island Arsenal
Third: *Weld Hardness Study*, T. Rice, Rock Island Arsenal

B. Plastics and Fibers

First: *Wetting Agent by Polarized Illumination*, A. F. Kirkpatrick, American Cyanamid Research Laboratory
Second: *Multilaminate of Resin and Paper*, T. G. Rochow, American Cyanamid Research Laboratory
Third: *Flax Fibers Swelling Test*, Anna T. Moore, Southern Regional Research

C. Macrographs of Particles

First: *Weathered Traffic Paint*, E. J. Thomas, American Cyanamid Research Laboratory
Second: *Spray Dried Detergent*, R. L. Gilbert, American Cyanamid Research Laboratory
Third: *Zunyite*, E. Golovato and H. F. McMurdie, National Bureau of Standards

D. Ores and Minerals

First: *Lead-Zinc Ore*, P. L. Merritt and E. J. Thomas, American Cyanamid Research Laboratory
Second: *Hematite and Ilmenite*, C. S. Rasor and E. J. Thomas, American Cyanamid Research Laboratory
Third: *Pyrite and Gangue*, F. W. Farwell and E. J. Thomas, American Cyanamid Research Laboratory

MEDALISTS AND AWARD WINNERS

N. L. Mochel (left) and P. R. Toolin ←

→ W. C. Hanna

N. L. Mochel, P. R. Toolin—Dudley Medalists

A native of Pittsburgh, Pa., Mr. Mochel was first employed in the Inspection Department of what was then Westinghouse Machine Co. in 1912, later taking over the work of the testing of materials. He continued in this capacity after the merger of the Machine Co. with the Westinghouse Electric and Manufacturing Corp. He served with the Engineers Corps of the United States Army in France during World War I. For many years Manager, Metallurgical Engineering of the Westinghouse Electric Corp., Philadelphia, Pa., he is an outstanding authority on metals, both ferrous and non-ferrous, and other materials going into the turbine and other forms of power generation. He has rendered notable service to the Navy, the National Advisory Committee on Aeronautics, and other branches of the Government in connection with many of their problems. He is a former officer of the Society, and for many years has been Chairman of Committee A-1 on Steel, and he has just retired as Chairman of the Joint Committee on Effect of Temperature on the Properties of Metals.

A graduate of the Massachusetts Institute of Technology with a B.S. degree in Mechanical Engineering, Mr. Toolin has been employed at the Westinghouse Electric Corp. since 1939 and has been at their Research Laboratories since 1940. He has been concerned chiefly with the determination of the physical properties of metals, particularly with high-temperature fatigue, and with the development of equipment for this work. He is a member of several technical societies.

W. C. Hanna—Thompson Award Winner

A native of Colorado, Mr. Hanna began his industrial work with the California Portland Cement Co. in 1903, where he has been Chief Chemist and Chemical Engineer for more than forty years. He attended Pomona College in California, taking special work. He has been very much interested in the manufacture of lime by the rotary kiln, aiding considerably in its development. His hobby is the study of ornithology, with over 20,000 eggs in his museum. He is a member of various technical societies. Very active in A.S.T.M., notably on Committee C-1 on Cement and C-9 on Concrete and Concrete Aggregates, he has served the Society in many other capacities. A member of the Board of Directors from 1944 to 1947, he was extremely active in connection with the Committee on Membership, which he headed for two years.

A. G. H. Dietz, G. S. Burr, W. J. Gailus, J. O. Silvey, S. Yurenka—Templin Award Winners

A graduate of Miami University, Oxford, Ohio, with an A.B. degree, Mr. Dietz received his S.B. and Sc.D. from the Massachusetts Institute of Technology. Following several years of work in construction and steel manufacture he returned to M.I.T. where he has been on the staff of the Department of Building Engineering and Construction. He is at present Associate Professor and Director of the Plastics Research Laboratory. During the war he was first briefly associated with the Forest Products Laboratory and later joined the Office of Field Service of the Office of Scientific Research and Development. He holds membership in various technical societies and is active in several A.S.T.M. Committees, including the new Committee C-21 on Structural Sandwich Constructions, of which he is temporary chairman.

A graduate of the Massachusetts Institute of Technology, receiving a Bachelor of Science degree, Mr. Burr was formerly employed with Ruge-deForest, Engineers, from 1940 to 1942, Lessels and Associates from 1942 to 1945, and M.I.T. from 1945 to 1947. At the present time he is Treas-

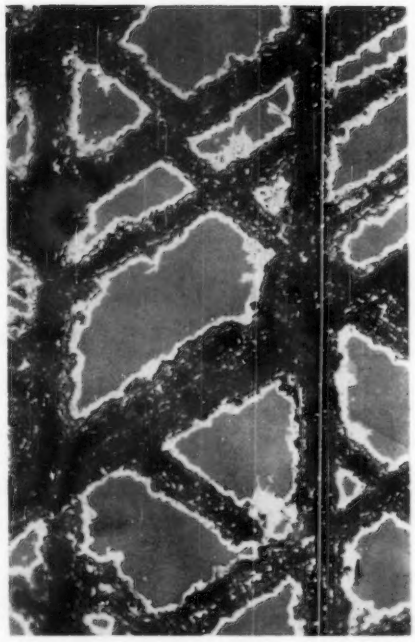
Left to Right—Messrs. Dietz, Yurenka, Silvey, Gailus, Burr

urer of Instron Engineering Corp., Quincy, Mass.

With a B.S. in Mechanical Engineering, from the University of Illinois, Mr. Gailus upon graduation, joined the research staff of the Plastics Division of the Monsanto Chemical Co. and began a study of high-temperature creep of phenolic plastics. More urgent war work led to his association with the Quartermaster Corps. as a civilian representative working on the development of body armor. When this project was terminated Mr. Gailus obtained leave to enroll at M.I.T. to study for a Doctor of Science degree in Mechanical Engineering. As Research Associate in the Department of Building Engineering and Construction he is at present continuing to study the properties of plastics and to work for his doctorate.

A graduate of the University of Illinois with a B.S. degree in Mechanical Engineering, Mr. Yurenka first began working for the Allis-Chalmers Manufacturing Co. in Milwaukee as a junior engineer in the company's two-year student training course. This training was interrupted by the war and he received leave of absence to engage in war work at the Navy Department and Naval Research Laboratory in Washington, D. C. At the conclusion of the war, Mr. Yurenka entered the Mechanical Engineering Department of M.I.T. as a candidate for a degree of Sc.D. in Mechanical Engineering and simultaneously engaged as a half-time research assistant in the Building Engineering and Construction Department under Dr. Dietz.

Mr. Silvey a graduate of the Agricultural and Mechanical College of Texas, with a B.S degree in Electrical Engineering, received his M.S. from the Massachusetts Institute of Technology. From 1939 to 1940 he did development work on waterwheel governors at Lombard Governor Corp., Ashland, Mass. In 1940 he joined the staff of the Servomechanisms Laboratory at M.I.T. where during the recent war years he did research and development work on fire control systems.



"Lead-Zinc Ore"

First prize-winning photograph, Photomicrographic Section (ores and minerals), in the Sixth A.S.T.M. Photographic Exhibit, by P. L. Merritt and E. J. Thomas American Cyanamid Research Laboratory. Polished surface of a lead-zinc ore, showing sphalerite being replaced along dodecahedral planes by other minerals; photomicrograph at 100 *X*.

Successful Committee Work

ONE cannot be truly successful in a cooperative enterprise such as A.S.T.M. represents unless he is interested in his fellow man as well as the technology of the problems that are being taken up. One of the major efforts of A.S.T.M. is to bring together a meeting of minds on what constitutes a fair and adequate method of testing and a specification for a material or product. It is true that some questions can be settled *solely* on technical and scientific merits, but that is frequently not true of a specification where engineering judgment and indeed compromise of viewpoints are necessary to success. Successful committee work involves an understanding of human nature and of the way to deal with people, and those who are most successful in this calling are those who have a genuine interest in trying to understand the other fellow's viewpoint and meeting him half way.—*A.S.T.M. Executive Secretary C. L. Warwick, in remarks at the dinner honoring Past-President H. S. Vassar on his retirement from active duties with the Public Service Electric and Gas Company.*

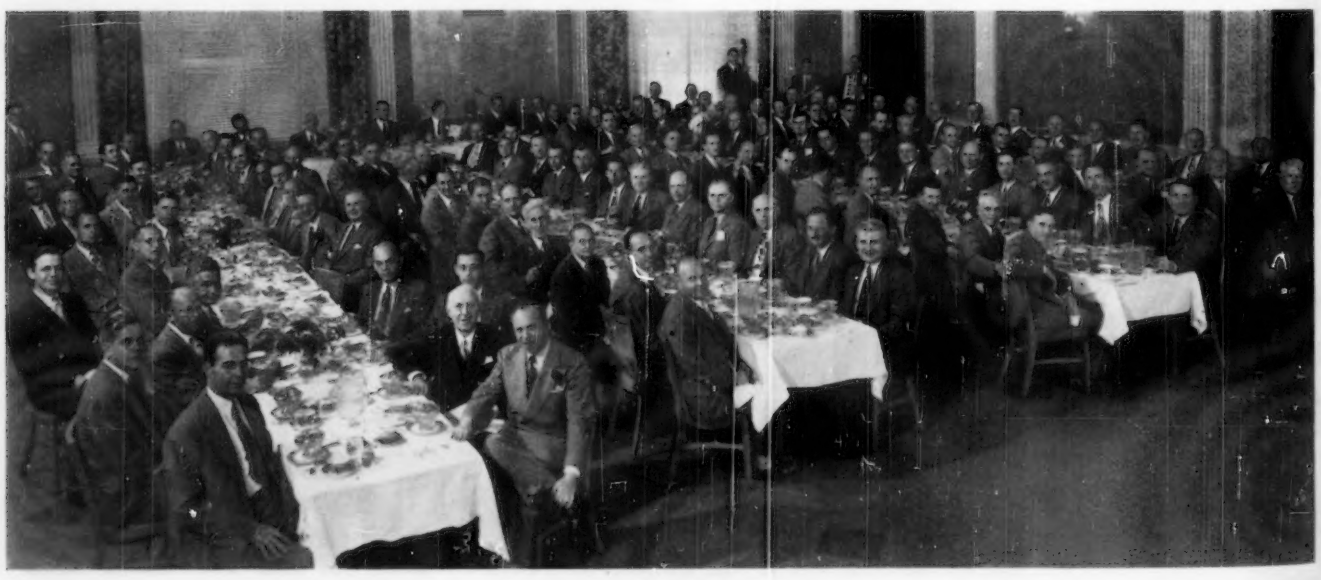
Membership Application Blanks

will be found in

1. Back of the Year Book
2. Back of Index to Standards
3. In some of the Special Compilations of Standards—

and a note to Headquarters will bring copies by return mail.

1948 Annual Dinner of Committee D-2 on Petroleum Products and Lubricants Honor Guest This Year Was Dr. A. E. Becker



List of New and Revised Tentatives with Serial Designations

THE Society accepted at the Annual Meeting 67 new tentatives and revisions in 73 former tentative specifications and methods of test. Of the revised tentative specifications and methods, 11 have been extensively revised and the titles of these are given below (marked with an asterisk) with the list of those issued by the Society for the first time. Standing committees responsible for the various items are indicated in italics.

Steel
(Committee A-1)

Methods:
Macroetch Testing and Inspection of Steel Forgings (A 317 – 48 T).
Tension Testing of Steel Spring Wire (A 318 – 48 T).

Cast Iron
(Committee A-3)

Specifications:
Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts (A 319 – 48 T).

Corrosion of Iron and Steel
(Committee A-5)

Specifications:
*Zinc-Coated (Galvanized) Iron or Steel Sheets (A 93 – 48 T) (Revision of standard and reversion to tentative).

Wires for Electrical Conductors
(Committee B-1)

Specifications:
Cored, Annular, Concentric-Lay Stranded Copper Conductors (B 226 – 48 T).
Hard-Drawn Copper-Covered Steel Wire (B 227 – 48 T).
Concentric-Lay Stranded Copper-Covered Steel Conductors (B 228 – 48 T).
Concentric-Lay Stranded Copper and Copper-Covered Steel Composite Conductors (B 229 – 48 T).
Hard-Drawn Aluminum Wire for Electrical Purposes (B 230 – 48 T).
Concentric-Lay Stranded Aluminum Conductors, Hard-Drawn (B 231 – 48 T).
Concentric-Lay Stranded Aluminum Conductors, Steel-Reinforced (ACSR) (B 232 – 48 T).
Rolled Aluminum Rods (EC Grade) for Electrical Purposes (B 233 – 48 T).

Method:
*Test for Resistivity of Electrical Conductor (B 193 – 48 T).

Electrical Heating, Resistance, and Related Alloys
(Committee B-4)

Methods:
*Test for Resistivity of Metallically Conducting Resistance and Contact Materials (B 63 – 48 T) (Revision of standard and reversion to tentative).
*Testing Sleeves and Tubing for Radio Tube Cathodes (B 128 – 48 T) (Revision of standards and reversion to tentative).
Test for Modulus of Elasticity of Thermostat Metals (Cantilever Beam Method) (B 223 – 48 T).

Cement
(Committee C-1)

Specifications:
*Portland Blast-Furnace Slag Cement (C 205 – 48 T).

Methods:
*Chemical Analysis of Portland Cement (C 114 – 48 T), comprising the addition of new methods for determining titanium oxide in portland cement.

Definition of:
The Term Addition as Applied to Hydraulic Cements (C 219 – 48 T).

Thermal Insulating Materials
(Committee C-16)

Method:
*Test for Water Vapor Permeability of Sheet Materials Used in Connection with Thermal Insulation (C 214 – 48 T).

Natural Building Stones
(Committee C-18)

Methods:
Test for Durability of Slate for Roofing (C 217 – 48 T).
Test for Combined Effect of Temperature Cycles and Weak Salt Solutions on Natural Building Stones (C 218 – 48 T).

Definitions of:
Terms Relating to Natural Building Stone (C 119 – 48 T).

Pigments and Paint Materials
(Committee D-1)

Specifications:
*Wood to Be Used as Panels in Weathering Tests of Paints and Varnishes (D 358 – 48 T).
*Pure Para Red Toner, Light (D 475 – 48 T) (Revision of standard and reversion to tentative).
*Pure Toluidine Red Toner (D 656 – 48 T) (Revision of standard and reversion to tentative).
Raw Castor Oil (D 960 – 48 T).
Dehydrated Castor Oil (D 961 – 48 T).
Aluminum Pigments, Powder and Paste, for Paints (D 962 – 48 T).
Copper Phthalocyanine Blue (D 963 – 48 T).
Copper Powder for Use in Anti-Fouling Paints (D 964 – 48 T).
Heavy Mineral Spirits (D 965 – 48 T).
Secondary Butyl Acetate (85 to 88 per cent Grade) (D 966 – 48 T).

Methods:
*Test for Acetone Extract in Black Pigments (D 305 – 48 T) (Revision of standard and reversion to tentative).
*Chemical Analysis of Zinc Yellow Pigment (Zinc Chromate Yellow) (D 444 – 48 T).
*Test for Specular Gloss of Paint Finishes (D 523 – 48 T).
Test for Heat Bodying Rate of Drying Oils (D 967 – 48 T).
Test for Abrasion Resistance of Coatings of Paint, Varnish, Lacquer and Related Products by the Falling Sand Method (D 968 – 48 T).
Laboratory Test for Degree of Resistance of Traffic Paint to Bleeding (D 969 – 48 T).
Testing Para Red and Toluidine Red Pigments (D 970 – 48 T).

Definition of:
Terms Relating to Paint, Varnish, Lacquer, and Related Products (D 16 – 48 T).

Petroleum Products and Lubricants
(Committee D-2)

Specifications:
*Aviation Gasolines (D 910 – 48 T), comprising new Grade 115-145.
Diesel Fuel Oils (D 975 – 48 T).

Methods:
*Test for Tetraethyllead in Gasoline (D 526 – 48 T) (Revision of standard and reversion to tentative).
Test for Interfacial Tension of Oil Against Water by the Ring Method (D 971 – 48 T).
Test for the Evaporation Loss of Lubricating Greases and Oils (D 972 – 48 T).
Determination of Butadiene Content of Polymerization Grade Butadiene (D 973 – 48 T).
Test for Neutralization Value (Acid and Base Numbers) by Color Indicator Method (D 974 – 48 T).
Test for Color of U. S. Army Motor Fuel (All-Purpose) by Means of an A.S.T.M. Color Standard (D 976 – 48 T).

Road and Paving Materials
(Committee D-4)

Specifications:
Emulsified Asphalt (D 977 – 48 T).
Asphaltic Mixtures for Sheet Asphalt Pavements (D 978 – 48 T).

Methods:
Sampling Bituminous Paving Mixtures (D 979 – 48 T).

Coal and Coke
(Committee D-5)

Methods:
Sampling and Analysis of Coal for Volatile Matter Determination in Connection with Smoke Ordinances (D 980 – 48 T).

Paper and Paper Products
(Committee D-6)

Methods:
Testing Analytical Filter Papers (D 981 – 48 T).
Test for Organic Nitrogen in Paper and Paperboard (D 982 – 48 T).
Test for Paraffin Wax Absorptiveness of Paper (D 983 – 48 T).
Test for Reducible Sulfur in Paper (D 984 – 48 T).
Test for 45-Degree, 0-Degree Directional Reflectance for Blue Light (Brightness) of Paper (D 985 – 48 T).
Preparation of a Magnesium Oxide Standard for Spectral Reflectivity (D 986 – 48 T).
Test for Stretch of Paper and Paper Products Under Tension (D 987 – 48 T).
Test for Water Vapor Permeability of Paper, Paperboard, and Other Sheet Materials (D 988 – 48 T).

Electrical Insulating Materials
(Committee D-9)

Methods:
*Test for High-Voltage, Low-Current Arc Resistance of Solid Electrical Insulating Materials (D 495 – 48 T) (Revision of standard and reversion to tentative).
Test for Detection of Free Sulfur in Electrical Insulating Oils (D 989 – 48 T).

Rubber Products
(Committee D-11)

Methods:
Test for Volume Resistivity of Electrically Conductive Rubber and Rubber-Like Materials (D 991 – 48 T).

Soaps and Other Detergents
(Committee D-12)

Methods:
Sampling and Chemical Analysis of Borax (D 501 – 48 T).

Textile Materials
(Committee D-13)

Specifications and Methods:
*Asbestos Yarns (D 299 – 48 T) (Revision of standard and reversion to tentative).
*Woven Cotton Tapes for Electrical Purposes (D 335 – 48 T) (Revision of standard and reversion to tentative).
*Woolen Yarns (D 403 – 48 T) (Revision of standard and reversion to tentative).
*Worsted Yarns (D 404 – 48 T) (Revision of standard and reversion to tentative).

Method:
*Test for Apparent Fluidity of Dispersions of Cellulose Fibers in Cuprammonium Hydroxide (D 539 – 48 T), comprising the addition of a new method for dispersions in cupriethylene diamine hydroxide.

Definitions of:
*Terms Relating to Textile Materials (D 123 – 47 T).

Recommended Practice for:
Planning Interlaboratory Testing of Textile Materials (D 990 – 48 T).

Industrial Water
(Committee D-19)

Methods:
*Test for Total Carbon Dioxide and Calculation of the Carbonate and Bicarbonate Ions in Industrial Waters (D 513 – 48 T) (Revision of standard and reversion to tentative).
*Field Sampling of Water-Formed Deposits (D 887 – 48 T).
Test for Nitrate Ion in Industrial Waters (D 992 – 48 T).
Test for Sulfate-Reducing Bacteria in Industrial Waters (D 993 – 48 T).

Quality Control of Materials
(Committee E-11)

Recommended Practice for:
*Designating Significant Places in Specified Limiting Values (E 29 – 48 T).

Publication Schedule for 1948—1949

Includes Supplements to Book of Standards, Special Compilations, and Special Publications; 10,000 Pages Estimated

THE Society's publication schedule for the remainder of 1948 and the first few months of 1949 presents the usual attractions to the printing industry and a well-filled roster for the staff. In addition to the regular 1948 publications, including the Proceedings, Supplements to Book of Standards, Year Book, Index to Standards and Tentatives, and the several compilations of standards, many symposiums and special publications are in prospect. It is estimated that the 1948 publications will aggregate some 10,000 pages.

Regular Publications

1948 SUPPLEMENT TO BOOK OF STANDARDS

The 1948 Supplements to the 1946 Book of Standards will be issued in five parts in heavy paper covers. They will include all new and revised standards and tentatives adopted or accepted at the 51st Annual Meeting or by the Administrative Committee on Standards, and will aggregate some 1500 pages.

1948 PROCEEDINGS

The practice of including certain papers published in the A.S.T.M. BULLETIN as well as those papers offered for *Proceedings* publication and presented at the 1948 Annual Meeting promises for a 1948 *Proceedings* of about 1100 pages. The papers presented at the Annual Meeting as a part of the special symposiums will appear in the symposium publications.

1948 INDEX TO A.S.T.M. STANDARDS

Members and other users of the Book of A.S.T.M. Standards will again be pleased to note the appearance of the Combined Index to Standards and Tentatives on the publication schedule. This is particularly significant in Supplement years in view of the increasing number of books in which standards may appear. Publication of this 1948 edition is scheduled for February, 1949, and should comprise about 250 pages.

1948 YEAR BOOK

The Year Book, containing a list of the complete membership and official company-member representatives (name, title, address, company, etc.) and also personnel of all A.S.T.M. committees, is furnished to members on request. The 1948 Book should aggregate 550 pages and is scheduled for distribution about November 1.

Combined Index to Committee Reports and Technical Papers—1951

The policy followed in past years of bringing out a combined index of all technical papers and reports published in all of the Society's publication issued over a five-year period should have produced such an index to cover the years 1941 to 1945. The appearance of this index had been delayed by the unfortunate postwar congestion in printing establishments throughout the country. The situation has been further complicated by the ever-increasing cost of printed matter. In addition to this the stock of three of the earlier combined indexes has become exhausted. In view of these conditions, the Administrative Committee on Papers and Publications has decided to pass over the 1941–1945 index that has already become very much overdue, and bring out a fifty-year combined index to cover all publications of the Society up to 1950. This publication will, of course, not be available until 1951. It will present a very useful addition to all

Committee Sponsoring	Title	Approximate Number of Pages	Approximate Publication Date
B-4	Electrical Heating and Resistance Materials	186	Aug.-Sept.
B-5	Copper and Copper Alloys, Cast and Wrought	510	Sept.-Oct.
B-7	Light Metals and Alloys, Cast and Wrought	170	Oct.-Nov.
C-9, D-4	Mineral Aggregates, Concrete, and Nonbituminous Highway Materials	289	Sept.-Oct.
D-4, D-8	Bituminous Materials for Highway Construction, Waterproofing and Roofing	310	Sept.-Oct.
D-2	Petroleum Products and Lubricants	756	Oct.-Nov.
D-5	Coal and Coke	170	Aug.-Sept.
D-6	Paper and Paper Products	290	Aug.-Sept.
D-9	Electrical Insulating Materials	600	Oct.-Nov.
D-11	Rubber and Rubber-Like Materials	616	Dec.-Jan.
D-13	Textile Materials	548	Sept.-Oct.
D-20	Plastics	610	July-Aug.

technical libraries and users of A.S.T.M. publications.

Special Compilations of Standards

The tabulation given below of special compilations of standards should be viewed only as approximate. There are so many factors affecting these books that it is not possible to give any accurate estimate of size or the date that they may become available. The size is affected by committee recommendations which may be coming through the Standards Committee and the date of issue is governed somewhat by editorial considerations, but to a great extent by the tremendous load our printers are carrying.

Special Technical Publications, Symposiums, etc.

1948 Annual Meeting Symposiums

Nine of the Symposiums that featured the 1948 Annual Meeting will be published separately with discussion, although some of them may be included in the 1948 *Proceedings* as well. These symposiums are listed below:

Symposium on Deformation of Metals as Related to Forming and Service.—Five technical papers; 60 pages.

Symposium on Test Methods and Procedures used in Identifying Reactive Materials in Concrete.—Six technical papers; 75 pages.

Symposium on Magnetic Testing.—Ten technical papers; estimated size, 120 pages.

Symposium on Usefulness and Limitations of Samples.—Three technical papers; 32 pages.

Symposium on Metallography in Color.—Five technical papers; 48 pages, including several color insert plates.

Panel Discussion on the Influence of Non-Ferrous Metals and Their Compounds on the Corrosion of Pressure Vessels.—Two technical papers; 30 pages.

Symposium on Speed of Testing.—Six technical papers; 90 pages.

Symposium on Functional Tests for Ball-Bearing Greases.—Five technical papers; 60 pages.

Symposium on Mineral Aggregates.—Fourteen technical papers; 180 pages.

Special Publications

Tables of Chemical Composition and Properties of Iron-Chromium and Iron-Chromium-Nickel Alloys:

In 1942 the Society collected and published information on wrought alloys in the above classifications. These data have been reviewed and revised and corresponding data have been assembled on cast alloys. All of this complete, up-to-date information will be published in a combined leaflet late in the fall.

Manual on Fatigue Testing:

The Manual on Fatigue Testing being prepared by Committee E-9 on Fatigue is progressing satisfactorily. Manuscripts of the eight sections, each prepared by an authority in his field, are now being reviewed by Committee E-9 and it is expected to have them in the hands of our printer this fall. The eight sections include:

Introduction.....R. E. Peterson
Nomenclature.....J. M. Lessells
Machines.....O. J. Horger
Specimens and Preparation.....J. B. Johnson
Test Procedure and Technique.....W. N. Findley
Presentation of Data.....L. R. Jackson
Interpretation of Data....R. L. Templin
Selected Bibliography.....T. J. Dolan

1948 Marburg Lecture:

The very timely lecture on "Isotopes and Their Application in the Field of Industrial Materials" by P. C. Aebersold, presented at the 1948 Annual Meeting, will be made available during the summer in separate pamphlet form in advance of its appearance in the 1948 *Proceedings*. Dr. Aebersold covered a subject that offers many possibilities for future developments.

X-ray Diffraction Data Cards—Second Supplement:

A second supplementary set of X-ray Diffraction Data Cards is now being accumulated. These cards will add new data to the 8500 cards now included in the Original and First Supplementary sets.

In preparing this new set, the committee in charge is considering the use of a new format to include a fourth line representing the greatest interplaner spacing. This, it is expected, will eliminate the necessity of cross index cards. This new format will be used when replenishing the stock of the Original and First Supplementary sets. It is also planned to prepare a combined index of the complete set of cards.

1946 Symposiums

Effect of Low Temperature on Materials: Spectroscopic Light Sources:

Both the Symposium on Low Temperature presented at a meeting sponsored by the Philadelphia District Committee on March 16, 1946, and the Symposium on Spectroscopic Light Sources, presented at the 1946 Annual Meeting, are awaiting completion. Seven of the eight papers in the Low Temperature Symposium and three of the four Spectroscopic Light Sources papers are in type. It is expected that final work on these symposiums can be completed this summer.

List of Pending Publications

(Discussed in Detail in Accompanying Article)

Regular Publications

1948 Supplement to Book of Standards
1948 Proceedings
1948 Index to A.S.T.M. Standards
1948 Year Book

Special Compilations

Electrical Heating and Resistance Materials
Copper and Copper Alloys, Cast and Wrought
Light Metals and Alloys, Cast and Wrought
Mineral Aggregates, Concrete, and Nonbituminous Highway Materials
Bituminous Materials for Highway Constructions, Waterproofing and Roofing, and Timber Preservation
Petroleum Products and Lubricants
Coal and Coke
Paper and Paper Products
Electrical Insulating Materials
Rubber and Rubber-Like Materials
Textile Materials
Plastics

Technical Publications and Papers

Tables of Chemical Composition and Properties of Iron-Chromium and Iron-Chromium-Nickel Alloys
Manual on Fatigue Testing
1948 Marburg Lecture
X-ray Diffraction Data Cards—Second Supplement

Symposiums[1]

Magnetic Testing
Usefulness and Limitations of Samples
Metallography in Color
Speed of Testing
Functional Tests for Ball-Bearing Greases
Mineral Aggregates
Panel Discussion on the Influence of Non-Ferrous Metals and Their Compounds on the Corrosion of Pressure Vessels
Deformation of Metals as Related to Forming and Service
Identifying Reactive Materials in Cement
Effect of Low Temperature on Materials
Spectroscopic Light Sources

[1] Some of these items may appear in the 1948 *Proceedings*.

Society Approves Standards on Steel Arc-Welding Electrodes and Plastics

As INDICATED in the accompanying table, the Administrative Committee on Standards on June 7 accepted recommendations from the Joint Committee on Filler Metal affecting steel arc-welding electrodes and also from Committee D-20 on Plastics. In each case the recommendations have been under consideration for an extended period in the committee, and the new or revised tentatives represent the best thoughts on which agreement could be reached in the technical groups.

Filler Metal:

The new tentative specification for low-alloy electrodes (A 316) and the revised one for mild steel material (A 233) were developed in the Joint Committee on Filler Metal which operates under the auspices of the American Welding Society and A.S.T.M. Actually the two documents represent a separation of the former Specification A 233. This splitting into two documents required the preparation of a new guide for the electrode low alloys which has been incorporated, and the guide to the mild steel material has been revised and expanded. Electrode classifications covered in revised A 233 are in the E45 and E60 series. Those in the low-alloy material are grouped into the E70, E80, E90, and E100 series These specifications are now in course of publication and copies will be available in separate pamphlet form either from the A.W.S. or A.S.T.M. headquarters.

Plastics:

The new Method of Measuring Shrinkage from Mold Dimensions (D 955) will provide a reliable method for comparing the results on plastic materials, and the procedure is intended to cover batch-to-batch uniformity in initial shrinkage. The new Tentative Recommended Practice for Molding Specimens of Amino Plastics (D 956) provides a method for which there has been a demand from both consumers and producers of these materials. Requirements are given for impact, flexural, and water absorption test specimens, etc. The new Recommended Practice for Determining Mold Surface Temperature of Commercial Molds for Plastics (D 957) is intended for determining the temperature at a specified point or points on the surface of the cavity and plunger of a commercial mold for plastics. By determining the temperatures at as many points as deemed necessary, the over-all temperature condition of the surfaces can be determined. The other new Recommended Practice D 958 covers two optional procedures for determining the temperature condition of standard A.S.T.M. molds for test specimens of plastics by means of either a thermometer or a pyrometer.

Revisions in the Test for Deformation of Plastics Under Load (D 621) include the addition of a section on the significance of the test, a new section covering a limiting value of deformation, and other changes bring the requirements in line with best current practice.

The new Tentative Method of Test for Bond Strength of Plastics and Electrical Insulating Materials (D 952) has important application in the evaluation of ply adhesive strength of sheet plastics and electrical insulation. It is applicable to such materials as laminated phenolics, laminated melamine with glass fabric base, and vulcanized fiber.

The various standards on plastics will be published separately, also in the 1948 Supplement to the Book of Standards, Part III-B, and will be included in the special compilation of standards on plastics which it is hoped can be published in August.

Actions of A.S.T.M. Administrative Committee on Standards, June and July, 1948

New Tentatives

Specifications for:
- Low-Alloy Steel Arc-Welding Electrodes (A 316 – 48 T)

Methods of:
- Test for Bond Strength of Plastics and Electrical Insulating Materials (D 952 – 48 T)
- Measuring Shrinkage from Mold Dimensions of Molded Plastics (D 955–48 T)

Recommended Practice for:
- Molding Specimens of Amino Plastics (D 956 – 48 T)
- Determining Mold Surface Temperatures of Commercial Molds for Plastics (D 957 – 48 T)
- Determining Temperatures of Standard A.S.T.M. Molds for Test Specimens of Plastics (D 958 – 48 T)

Revision of Tentatives

Specifications for:
- Mild Steel Arc-Welding Electrodes (A 233 – 48 T)

Methods of:
- Test for Deformation of Plastics Under Load (D 621 – 48 T)

Forum on Tractor Fuels

INCLUDED among the publications scheduled for release in the fall is a "Forum on Tractor Fuels" sponsored by Technical Committee L on Tractor Fuels of A.S.T.M. Committee D-2. Held at the initial meeting of Technical Committee L in Chicago, Ill., on January 9, 1948, this forum is a survey of the complex problems facing manufacturers and users of tractors resulting from conflicting state tax regulations and a lack of standardization of tractor fuels.

Mr. Earl M. Hughes representing the Illinois State Agricultural Association, chairman of the technical committee, presided at the meeting where the papers were presented. They are as follows:

Tractor Statistics as Related to the Farmer, H. E. Everett, Editor and Vice President, *Implement and Tractor*.

The Farmers' Interest in Tractor Fuels, E. L. Barger, Agricultural Engineering Department, Iowa State College.

A Review of Tractor Requirements as Related to Fuels, Raymon Bowers, Assistant Chief Engineer, Mechanical Research and Development Division, International Harvester Co.

The Complexity of Tractor Fuels and Taxation, A. B. Anderson, Director of Petroleum Division, Department of Taxation, State of Minnesota.

The Effect of State Regulations and State Specifications on Tractor Fuels from the Petroleum Industry Standpoint, C. N. Hinkle, Tractor Representative, Sales Technical Service Dept., Standard Oil Company (Indiana).

Each member will be advised when the publication is available and given an opportunity to order copies.

List of American Standards

An up-to-date list of all national standards approved by the American Standards Association has just been published and is now available free of charge. The American Standards listed have been developed through the procedure of the ASA by the national groups in each of the fields covered, ranging from civil engineering and construction, mechanical engineering, electrical engineering to chemicals and textiles.

The list includes national standards for such important problems as dimensions of machine tools and parts, rating and testing of electrical equipment, dimensions and identification of pipes and piping, building code requirements, industrial safety and health, occupational clothing, photography, and definitions, abbreviations and symbols used in technical literature.

The new price list makes available a complete set of All American Standards at $225 and a complete set of all American Safety Standards at $35. Quantity discounts range from 20 per cent to 45 per cent for quantities up to 1000 copies.

Copies of the list can be obtained from the American Standards Association, 70 East 45th St., New York 17, N. Y.

A Large Number of Current Standardization Projects in Technical Committees

Much Activity Under Way on Numerous Materials

In each August issue of the ASTM BULLETIN there is given a "round-up" of important standardization activities which may be under way in the various technical committees. The material which follows provides some conception of these. The information is based in part on current reports of the technical committees, and in large measure on statements of programs of work which the technical committee officers have been asked to send to Headquarters. Much of this information is of interest to the membership broadly, and it is a great help to the Staff and to the Administrative Committee on Standards in providing a look-ahead.

Arrangement of Material

The material which follows is arranged in general in the order of the designations of the Technical Committees, the "A" and "B" groups, Ferrous and Non-Ferrous appearing first, followed by the "C," "D" and "E" groups.

Ferrous and Non-Ferrous Metals—"A" and "B" Committees (see also "E" Groups)

Steel (A-1)

Due to the increased demand for specifications for steel suitable for low temperature service, Committee A-1 has been actively engaged in writing such documents. The Tentative Specifications for Steel Plates for Pressure Vessels for Service at Low Temperatures (A 300 – 47 T) were published in 1947. On April 23, 1948, the Tentative Specifications for Alloy-Steel Bolting Material for Low-Temperature Service (A 320 – 48 T) were approved for publication. Specifications for low-temperature material on which work will be concentrated during the coming year include pipe, tubing, forgings, and castings.

Another project includes the development of a document to include tables of permissible variations, tolerances, and related information and data on requirements which are common to various boiler plate specifications. A similar document for structural steel has been completed and should be published this year, together with the several revised product specifications.

Thirteen forging specifications have been given a very thorough going over. This work on modernizing and correlating the specifications is in its late stages and the results will soon be published.

Two new bar specifications will soon appear in print, covering heat-treated carbon steel and hot-rolled alloy steel. In addition work is under way on a proposed specification for soft steel carbon steel bars puchased to mechanical properties. If this specification becomes feasible then it might seem desirable to eliminate references to bars in certain of the present structural specifications and use the new document in their place.

Cast Iron (A-3)

Committee A-3 is continuing the Specifications for Gray Iron Castings for Pressure Containing Parts for Temperatures up to 650 F. (A 278) as tentative because the committee feels that additional information on creep strength of various cast irons is desirable to facilitate the wider adoption of the specification. A survey will be made to determine if sufficient funds can be raised by Committee A-3 to finance such a program on which the committee will consult with the Joint Research Committee on Effect of Temperature on the Properties of Metals.

Corrosion of Iron and Steel (A-5)

The Subcommittee on Methods of Testing of Committee A-5 has under consideration a proposed revision of the Standard Method of Test for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles (A 90) covering an additional stripping method in which hydrochloric acid diluted with an equal amount of water is used. This new method, it is hoped, will be rapid enough for a shop floor check during production. The Section on Preece Test will review Sections 8 and 12 of the Standard Method of Test for Uniformity of Coating by the Preece Test (Copper Sulfate Dip) on Zinc-Coated (Galvanized) Iron or Steel Articles (A 239) to eliminate the ambiguity in the definition of "end point" as now given in these sections.

A section of the Subcommittee on Wire Specifications is studying the need for a specification for stock fence such as is covered by the Department of Commerce Simplified Practice Recommendation R9-47. A review is being made of the Standard Specifications for Zinc-Coated Iron or Steel Chain Link Fence Fabric Galvanized After Weaving (A 117) to make it conform with present manufacturing practices. Active work is in progress on a new specification for galvanized high-strength steel telephone and telegraph line wire.

The committee considers that the hardware tests now under way are too limited in scope and it has been suggested that other committees should be asked to participate so that ferrous and non-ferrous base metal, plastics, paints, and metallic coatings can be tested. The Advisory Subcommittee of Committee A-5 will consult with other committees to obtain their views on this matter.

Magnetic Material (A-6)

The proposal for an editorial rearrangement of Specification A 34 which had been developed by a special subcommittee, of which Mr. R. C. Taylor of the Western Union Telegraph Company is chairman, had been circulated to all the members of Committee A-6 prior to the June meeting. This proposal met with general approval and will be carried out during the next year.

Subcommittee III is working on a revision of the specifications relating to d.-c. testing methods and a small group for Subcommittee IV has been considering the advantages of the Franklin tester for interlamination resistance. It was the opinion that this might well be adopted as a method primarily for quality control and such specifications will be drawn up. Work has also been started on a method for determining the height and condition of the burr on punched or sheared specimens.

Malleable Iron Castings (A-7)

Committee A-7 has had a gratifying increase in membership during the past year and expects to continue its active program of keeping its specifications up to date. An important item which the committee has in hand is the problem of developing a standard white iron sample for the malleable iron industry. Considerable progress has been made on this project and in cooperation with the National Bureau of Standards the committee hopes to complete it in the near future.

Ferro-Alloys (A-9)

Committee A-9 on Ferro Alloys, reactivated during the year just passed, expects to prepare during the current year two new specifications, one for ferrotitanium, the other for ferroboron and also to revise the Specifications for Molybdenum Salts and Compounds (A 146 – 39), including the material now in Method E 66 for sampling this product.

Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys (A-10)

During the Annual Meeting, Committee A-10 completed minor revisions in the Specifications for corrosion-resisting steel castings (A 296) and heat-resisting castings (A 297) to reconcile differences between these two specifications and the published data of the Alloy Casting Institute. As soon as the letter ballot is complete on these and on Specifications A 276 covering hot-rolled and cold-rolled bars, they will be submitted to the Administrative Committee on Standards. Another specification, prepared jointly by Committees A-10 and A-1, that for Seamless and Welded Austenitic Stainless Steel, has been approved by Committee A-10 but is waiting action in Committee A-1.

Revisions in the Methods for the Boiling Nitric Acid Test (A 262) and the Total Immersion Test (A 279) are under discussion. The new edition of the A-10 Data Book on Corrosion-Resistant Steels, which will include cast alloys as well as wrought will be published before the end of the year.

The Subcommittee on Atmospheric Exposure Testing is ready to go forward with its program as soon as the matter of test sites has been cleared by the Advisory Committee on Corrosion. The Subcommittee on Mechanical Test Methods is now getting under way with its fourth round-robin program of tension testing in which particular attention will be given to the necessity for the maintenance of an extremely uniform temperature during the testing which may prove to be even more important than the rate of strain.

Another subcommittee is continuing its study for the sigma phase in the corrosion-resistant steels and has distributed to the laboratories that are cooperating a set of specimens for testing. The committee has initiated a proposal for a symposium in 1949 dealing with the significance of the nitric acid test and the acid copper sulfate test for corrosion-resistant steels.

A.W.S.-A.S.T.M. Joint Committee on Filler Metal

As noted elsewhere in the Bulletin, the A.W.S.-A.S.T.M. Joint Committee on Filler Metal completed a very active year of work on specifications, but the coming year promises to be just as busy. It is expected that some minor revisions will be proposed in the Specification for Iron and Steel Gas-Welding Rods (A 251) and there may be minor changes in the two steel arc-welding electrode Specifications, A 233 and A 316.

The Subcommittee on Aluminum and Aluminum Alloy Filler Metal has been busy writing a new specification for this material but did not complete its work before June. Certain tests must be finished before the final provisions for the specification can be written but it is expected that this will be completed during the current year. The Subcommittee on Capillary Brazing Materials has a backlog of uncompleted assignments from last year and expects to come forward with recommendations during the next twelve months.

Wires for Electrical Conductors (B-1)

While Committee B-1 can look back on a year of very active work in the writing of new specifications, the committee expects to continue a number of other projects during the current year. One of these is a solution to some of the controversial provisions which existed for a number of years regarding an acceptance test for contour in the trolley wire specification. Agreement has been reached and tentative revisions of these specifications will be submitted shortly to the Administrative Committee on Standards. The Subcommittee on Copper Conductors is preparing a clause covering weight-density method for area determination and is reviewing all tolerances. The problem of edgewise bending has been referred to the Non-Ferrous Coordinating Committee to secure cooperation of the other committees which are faced with this same problem.

The Subcommittee on Methods of Test is actively engaged in the project of consolidating and coordinating methods of test used throughout the committee's specifications with special reference to a practical sampling procedure following the pattern set by Committee E-11. The Subcommittee on Conductors of Ferrous Metals is working on a specification for the steel wire used for reinforcement of aluminum cable.

Non-Ferrous Metals and Alloys (B-2)

Committee B-2 expects to submit shortly to the Society minor changes in the Specifications for Babbitt (B 23) and for Solder (B 32). During the current year specifications for antimony should be completed and also proposed revisions in the Specifications for Lead-Coated Copper Sheets (B 101). The eleven specifications of the committee covering nickel and nickel alloys are all being reviewed and revised.

Corrosion of Non-Ferrous Metals and Alloys (B-3)

Committee B-3 is instituting in several laboratories cooperative tests of the procedure described in the Tentative Method for Total Immersion Corrosion Testing (B 185) and also has a group reviewing the factors affecting salt spray fog testing covered in Method B 117.

A group will work actively during the current year on the preparation of a method of humidity testing while the Subcommittee on Atmospheric Corrosion is working with Committee B-7 on atmospheric tests on magnesium alloys. A subgroup is studying the relative corrosivity of the various A.S.T.M. test sites and the Subcommittee on Galvanic and Electrolytic Corrosion expects to institute a test program during the year on magnesium alloys coupled with other metals.

Electrical Heating, Resistance, and Related Alloys (B-4)

Committee B-4 is making check tests to determine the importance of voltage regulation in the Method for Accelerated Life Test for Metallic Materials for Electrical Heating (B 76). A hardness testing procedure for thermostat metals is also being developed.

The Section on Cathode of the Subcommittee on Metallic Materials for Radio Tubes expects to continue very active work in its study of the emissivity of cathode nickel. Several test methods and outlines of procedure to be followed are scheduled to be written during the current year. A Method of Test for Particle Size will be completed shortly. The subcommittee is also working on the development of a method for sag testing of tungsten filaments and on the problem of the tensile testing of fine wire.

The Subcommittee on Methods of Test for Alloys in Controlled Atmospheres continues to study the phenomenon of green rot. The Subcommittee on Contact Materials has established a new section to study micro-current contacts.

Copper and Copper Alloys, Cast and Wrought (B-5)

In Committee B-5, the Subcommittee on Plate, Sheet, and Strip is studying the revision of requirements for mechanical properties in Specifications B 194 and B 195, the writing of specifications to cover aluminum bronze plate and sheet for A.S.M.E. Boiler Code requirements, the revision of copper limits for alloys Nos. 4 and 6 of Specification B 121, the addition of rolled bar to plate specifications and the narrowing of tin limits and the addition of grain size limits in Specifications B 103.

The Subcommittee on Rods, Bars, and Shapes has under consideration the possible deletion of bend tests in rod and bar specifications, the inclusion of additional size range in Specifications B 133 and B 187, the revision of requirements for mechanical properties in Specifications B 150, the revision of elongation requirements in rod and bar specifications, the narrowing of tin limits in Specification B 139, and the revision of chemical limits for alloy No. 11 in Specifications B 124.

The Wire and Wire Rod Subcommittee is studying the narrowing of tin limits and the substitution of grain size limits for strength requirements in Specification B 159 for phosphor bronze rod.

Among the subjects being studied by the Subcommittee on Pipe and Tube are the development of requirements for dehydrated and sealed refrigeration tubes in Specification B 68, the revision of dimensional tolerances in Specification B 111, and the deletion of weight tolerance in Specification B 88. The temper requirements of Specification B 75 are being reviewed as to their adequacy.

The Subcommittee on Castings, and Ingots for Remelting has under way the revision of sampling requirements in Specifications B 30 and the preparation of appendices for Specifications B 147 and B 198 to cover manufacturers' published composition limits for specific alloys. A task group continues its extensive study of test bars and test bar practices.

The Subcommittee on Methods of Test is studying the effect of speed of testing on tensile properties and the relation of Rockwell hardness to thickness of specimen.

The Subcommittee on Editorial and Publications continues a study of the correlation of the chemical limits and of the nomenclature and classification of wrought alloys under the jurisdiction of the committee. It is also studying the preparation of a recommended form for Committee B-5 standards, and is preparing a history of the committee.

Die-Cast Metals and Alloys (B-6)

Committee B-6 is preparing a specification for zinc-base die casting alloy ingot. The study of die-casting processes continues actively with four task groups assigned to specific projects: Group A on metal and die-temperature studies; Group B on studies of pressure, speed, and gate velocity; Group C on studies of gating, dwell time, die dressings and lubricants; and Group D on studies of melting practices.

Light Metals and Alloys, Cast and Wrought (B-7)

Committee B-7 is working on revisions in Specifications B 26, B 108, and B 179 which it expects to submit to the Administrative Committee on Standards before the end of the year. The committee is also working on several new specifications for wrought aluminum alloys and is studying the questions of frequency of sampling, type of specimens, and location of specimens in wrought products.

The Subcommittee on Anodic Oxidation of Aluminum and Aluminum Alloys is considering the question of whether or not, in the light of recently available information, it should prepare a method covering the use of the filmeter in measuring the thickness of anodic coatings.

A special subcommittee has been appointed to complete the plans for the proposed atmospheric corrosion tests of light alloys and two representatives of the committee have been appointed to a joint task group of several "B" Committees which will consider methods for making edgewise bending tests of rectangular wrought metal.

Electrodeposited Metallic Coatings (B-8)

Committee B-8 has under review all of its specifications. The Subcommittee on Performance Tests plans to present a report next year on the continuing exposure tests of copper-nickel-chromium on steel and electrodeposited lead on steel.

The Subcommittee on Conformance Tests has three working sections continuing their active programs and a fourth section on metal brightness tests has been formed. This new section will start at once on the problem of evaluating the luster of metal coatings.

The Subcommittee on Electroplating Practice is developing recommended practices for the preparation for plating of various metals, including high-carbon steel, zinc-base die-castings, copper-base alloys, stainless steels, and aluminum.

The Subcommittee on Supplementary Protective Finishes for Metallic Coatings is reviewing the Tentative Specifications for Chromate Finishes on Zinc Surfaces (B 201). The present practice for phosphate type treatments of zinc-plated steel is also being surveyed. A long-range program for surveys and reports on recommended practices for various supplementary treatments and special methods of testing has been inaugurated.

Metal Powders and Metal Powder Products (B-9)

Committee B-9 has reached preliminary agreement on a standard tension test bar for use by the powder metallurgy industry. Two types of bars are recommended; one to be tested in the machined condition and the other, unmachined. A cooperative program of tests of the two bars has been initiated. Technical data sheets on materials covered by the Specifications for Metal Powder Sintered Bearings (B 202) and Structural Parts (B 222) are being prepared.

A Method for Compressibility of Metal Powders has been developed and will probably be completed in final form before the end of the year. The committee is working actively with Committee E-3 on Chemical Analysis of Metals on the application of present, and the preparation of new, methods for chemical analysis that can be used in the metal powder field. The study of the Roller air analyzer and of a microscopic method for determination of subsieve particle size continues.

The Section on Bearings has reached substantial agreement on uniform press fit allowances and running clearances and is actively engaged in preparing a list of standard sizes for cylindrical bearings. The Section on Structural Parts has initiated a program for the correlation of the properties of such parts made from metal powder with the properties of the anticipated standard test specimens.

The "C" and Some "D" and "E" Groups

Cement (C-1)

Much activity in the field of portland cement continues both in requirements for specifications and in the development of test methods. The principal emphasis in specification requirements is chemical which has led to a recommended revision of the Specification for Portland Cement (C 150) in the matter of limits for alkali content of cement to be used with reactive aggregates. A cooperative study will be made of the flame photometer for use in making quick determinations of the alkali content in portland cement. The committee's Primary emphasis in research work relates to the chemical reactions of aggregates in concrete when used with certain cements, and a test procedure for determining whether deleterious reactions are likely to occur with a given comparison of cement and aggregate is being studied. Plans for new cooperative tests for studying sulfate resistance have been perfected. A proposed method of test for setting time of hydrated cement in mortar is being published as information and to elicit comments.

Projects which are being continued include a study of the heat of hydration of portland cement at early ages; a tentative flow table design is being circulated preliminary to preparing a specification; a cooperative investigation for the purpose of developing information as to the relative merit of tensile, compressive, and flexural strengths of mortar specimens in predicting the flexural and compressive strengths of concrete; and 10 laboratories will participate in cooperative tests of nine cements using the present Tentative Method C 185, the current Federal government test and the constant water content method in determining the water requirements for standard mortar.

Research in methods for determining titanium oxide in portland cement has resulted in the presentation of three new methods for inclusion in the tentative Methods of Chemical Analysis of Portland Cement, C 114 T. A new series of tests are being undertaken to establish data for a durability specification for masonry cement. Studies of tests for pozzolanic activity in blended cements is being continued.

Magnesium Oxychloride Cements (C-2)

Following the submittal of nine tentative methods of test covering physical and chemical properties of magnesium oxychloride cements, Committee C-2 is actively engaged in a review of additional test methods involving flow table consistency, setting time, linear change, linear contraction, an analysis of oxychloride magnesia, and a specification for oxychloride magnesia. Further activity of the committee will be in the development of methods of test for soundness in the determination and prediction of volume changes and other characteristics of oxychloride flooring by means of which estimates of its reasonable life and service can be established.

Clay Pipe (C-4)

Committee C-4 on Clay Pipe is continuing its review of existing specifications for clay pipe based on extensive research which has been in process.

Lime (C-7)

Specifications for lime for use in the chemical industry is receiving continued attention along the line of separate specifications for each particular chemical use. Specifications for lime for use in the petroleum refining field and the leather industry are in the final stages of development. Research will be emphasized during the coming year on an accelerated test for potential expansion of lime products and on methods for measuring workability.

Refractories (C-8)

Two new fields of research have been included in the activity of Committee C-8, one being on carbon refractories as such and products which contain carbon, including graphite. One of the principal problems will relate to the use of carbon refractories in blast furnaces. The other new project involves the disintegration of refractories by carbon monoxide for which the committee expects to recommend a standard procedure. A questionnaire has been sent to all laboratories which may be carrying out tests of this nature. This information will serve as a basis for the selection of the features to be incorporated in a tentative test method.

Research work is being carried on at several colleges including Penn State College and the Missouri School of Mines and Metallurgy on load tests. Research work on temperature is under way on the comparison of various types of P.C.E. furnaces with standard samples or cones. The possible use of a panel test in obtaining the linear change of insulating fire brick during heat treatment is being investigated. A "practical" short test for determining thermal conductivity of refractories at relatively high temperatures is being studied, as a result of the work of Dr. H. C. Dickinson of the National Bureau of Standards.

Aggregates (C-9)

One of the most active research projects in Committee C-9 is that on chemical reactions of aggregate in concrete. One phase of this is the study of various correctives of alkali reaction such as shale and fly ash. Study of volume change due to variation in moisture and temperature rather than from chemical reactions between cements and aggregates is receiving the attention of a subcommittee. Other primary research included in the activities of the research subcommittees includes that on durability, dynamic testing, and mineralogical characteristics of aggregates. The subcommittees concerned with the development of test methods and specifications have under consideration procedures for the measurement of entrained air by pressure methods, measurement of bleeding and evaluation of bond particularly as effected by admixtures. A major revision of the specification on lightweight aggregates is nearing completion.

Mortars (C-12)

Investigation of methods of determination of efflorescent tendencies of mortars is still being continued by Committee C-12 on Mortars for Unit Masonry. Results of an examination of the various waterproofing treatments for masonry walls were presented in a paper on this subject at the 1948 Annual Meeting. A proposed method of analyzing fresh mortars as used by the mason and taken from the construction site has been developed for publication as information only in the ASTM Bulletin. A study is in progress on pointing mortars with special reference to the age of re-tempering and admixtures and the ability to get a tight joint between the mortar and the unit. The relation between the unit weight of mortars and cement products and their strength, extensibility, shrinkage, and creep properties will be studied.

Glass and Glass Products (C-14)

Durability tests on glass are in progress in Committee C-14 intended to cover conditions of service, in conjunction with similar work on glass containers for which tentative test methods are now being prepared. A new subcommittee on illuminating glassware is contemplated. Studies are being made on the formulation of requirements for impact tests on glass containers.

Manufactured Masonry Units (C-15)

The scope of Committee C-15 has been expanded during the past year so that new fields of activity will be studied. A new subcommittee on chemical resistant brick is being organized which will continue studies of a proposed specification. Drain tile, new to C-15 but old in A.S.T.M. activity, will be under the jurisdiction of a new subcommittee which will consider the need for any further revisions of this specification. Revisions of the standards on concrete masonry units are under consideration for the purpose of clarifying portions of the standards that heretofore have led to more than one interpretation. Modular size coordination has prompted major revisions of the standards for clay building units in respect to conformity of dimensions.

Thermal Insulating Materials (C-16)

The committee structure of Committee C-16 is based mainly on types of products used, each subcommittee being concerned with both research and formulation of standards covering its own particular field or product. In the block and pipe insulation field product specifications covering all types are being developed along with test data on handleability. Troweling properties and the influence of water-cement ratio on insulating cements will be investigated and also work on the formulation of compression-shear or compression test methods. A fire-resistant test is being formulated for blanket insulation. Other properties being considered for this type of product include thermal conductivity, compressive strength, corrosion, and water absorption.

The chief attention being given to the study of loose fill insulation is that of density measurement and the closely related topic of settling and vibration effects. A method of determining thermal conductivity of pipe insulation is being developed using optional types of equipment other than the guarded hot plate. Methods of measurement of thermal conductivity at very low mean temperatures and measurement of surface temperatures are of concern to the committee. Progress is reported on round-robin tests on methods of specific heat measurement. Methods of measuring clearances and tolerances of pipe insulation and pipe are being considered in arriving at satisfactory dimensional standards.

Asbestos Cement Products (C-17)

The activities of Committee C-17 have been confined mainly to the adoption of tentative methods of tests which will be used in setting up requirements for specifications on several asbestos cement products. Strength, deflection, and water absorption will be the chief criteria in setting up specifications on asbestos cement roofing shingles and flat asbestos cement sheets. Consideration is also being given to specifications for asbestos cement siding and corrugated board.

Natural Building Stones (C-18)

Specifications for roofing slate and for marble, respectively, are now under consideration by Committee C-18. The specification on roofing slate is similar to the federal specification on this product except for the means of determining durability. Two problems in connection with roofing slate, namely the development of a test that will classify slates with respect to their susceptibility to breakage on the roof and a test to determine the permanence of color in green slates are under consideration, both requiring considerable research work. Research has been conducted for the purpose of finding a suitable durability test for the very dense, crystalline stones.

Structural Sandwich Constructions (C-19)

Four subcommittees have been formed since the recent organization of Committee C-19, with all four actively pursuing their work. A study of the materials of which sandwich constructions are made is under way with initial emphasis being placed on those basic materials which are used as cores. The properties of core materials established by adequate tests will be presented in the form of a data sheet. The study of the sandwich constructions themselves in so far as chemical and physical properties are concerned will represent the most difficult work of the committee in that it will be a new field of endeavor. Permanence and simulated service testing will represent the activities of one subcommittee with a fourth subcommittee having as its initial effort the forming of the definition of the term "structural sandwich constructions." (See another article in this Bulletin on the organization of this new A.S.T.M. technical committee.)

Road and Paving Materials (D-4)

The effect of water on compressed bituminous mixtures as well as on bituminous coated aggregates has led to the formation of two new subcommittees in Committee D-4, to study and develop testing methods. This is an enlargement of the work of the existing subcommittee on resistance to film stripping of bituminous aggregates which will now be discontinued. A series of cooperative tests has been outlined in carrying out this work. Other subcommittees are studying methods in use for evaluating the setting qualities of bituminous materials, the physical properties of compressed bituminous mixtures, and the asphalt content of liquid asphaltic

road materials. The preparation of a standard method is in progress for the determination of Engler specific viscosity. A review of the existing standard method for the float test will also be made.

Paper and Paper Products (D-6)

In addition to the several proposed test methods presented at the Annual Meeting by Committee D-6, an imposing list of subjects which are under consideration by the subcommittee on paper testing methods is noted. These include abrasion, fiber identification, gloss, linting, moisture expansivity, permanganate number, stiffness, total chloride content of paper, and zinc pigments in paper. Studies are being continued which may lead to proposed revisions in the Standard Methods of Test for Basis Weight of Paper and Paper Products (D 646) and Hydrogen Ion Concentration (pH) of Paper Extract (D 778).

The subcommittee on specifications is currently developing standard specifications for filter paper for chemical analysis. The subcommittee on container board is working on the following test procedures: adhesion test of component parts of corrugated board, beam test, bursting strength of paper board, flat crush test, immersion test and delamination of plies, ring crush test, and static bending test.

Wood (D-7)

The preparation of a proposed method for the testing of the adequacy of glued laminated lumber for exterior uses is receiving attention in Committee D-7, with control tests in progress in several laboratories for the purpose of collecting data for a specification on laminated lumber for both exterior and interior use. The committee members have expressed the need for a specification for plywood and in considering the requirements three projects were recommended, namely, a glossary of terms covering veneer defects and plywood manufacturing details, a species grouping based on relative strength, and descriptions of veneer quality.

Consideration is being given to two additional specifications on wood paving blocks, covering untreated blocks and blocks treated with preservatives other than creosote, both for interior use. Comparisons are being made of existing A.S.T.M. standards on timber preservatives with standards of other organizations. A subcommittee is reviewing existing information pointing toward the establishment of sets of conditions in a specification covering modified wood and wood based materials. A development of a new secondary standard for testing wood based on specimens 1 by 1 in. in cross-section is in progress and on new test methods covering fiberboard of both the hard and insulating types. Further revision is in process on the proposed method for determining the moisture content of treated wood preparatory to publication in the A.S.T.M. Bulletin. A new subcommittee on wood poles and cross arms will initially attempt to develop a method for the static testing of poles. It is expected that a new subcommittee will be activated during the coming year to study durability and exposure effects on wood.

Bituminous Waterproofing and Roofing Materials (D-8)

A new subcommittee has been formed in Committee D-8 to study the compatibility of bituminous materials. It will first look into variables in current tests now being used with the objective of standardization where possible. New specifications are under study on the grading of granules. The testing of cold-applied roofing materials is receiving continued attention and work on a specification for insulated siding materials, this being an additional field now included in the scope of the committee, will be inaugurated.

Shipping Containers (D-10)

An outline of the program of work of Committee D-10 includes test methods for large size containers or crates, a study of test methods for localizing impact such as snagging and puncture, and programs of work leading to the establishment of permanence standards. A more detailed report on the activity of this committee may be found in the May, 1948, Bulletin which gives a summary of the Cleveland meeting held on April 26 and 27.

Adhesives (D-14)

One phase of standardization receiving much attention in Committee D-14 is that of determining strength properties. The present test for tensile properties has now been found to be both practical and usable for materials other than wood, including metals, and present activities are being devoted to developing a simplified method. Other strength properties for which test methods are being prepared, or have been prepared, include metal-to-metal shear strength, impact strength, fatigue, flexural, 90-degree peel, and cleavage.

In studying the effect of moisture and temperature on permanence of adhesives a method of continuous exposure tests is being perfected. Suggestions are being considered for provisions for preconditioning of samples and to permit presoaking. Conditions have been agreed upon in the test work on cycling tests to include the following types: interior moderate, interior severe, exterior land and aircraft, and exterior marine. Round-robin tests are now in process to study the effect of light on permanence of adhesives using various light machines. Comments are to be elicited on a tentative procedure for ascertaining the effect of biological factors on pe manence of adhesives.

Various aspects of the working properties of adhesives are receiving attention. This includes round-robin tests on measuring tack and blocking. In the latter case, the present A.S.T.M. method under the jurisdiction of Committee D-20 is being revised in order to be adaptable for use in the adhesives field. Other working properties being studied include rate of strength development, consistency, storage and working life, and gap filling. The committee has given much consideration to the type of specification which is felt to be most desirable to formulate. Tentative agreement has been reached on specifications based on performance with the privilege of specifying the best chemical type of material. The initial effort is a specification for adhesives suitable for adhering wood-to-wood. Many fundamental research problems have been considered with the emphasis being on pure strength properties. A new subcommittee has been established to study the electrical properties of adhesives.

Soils (D-18)

Standardization activities in Committee D-18 at present are concentrated in the many small research subcommittees which have been established under the new organization. The subcommittees which will be concerned with specifications have not as yet been completely organized. The many research programs involve requirements for a consolidation test, development of a tentative method for making direct shear tests, various methods of performing and interpreting triaxial compression tests, investigation of fine-grained soils with the objective of developing unified procedures for establishing the various physicochemical properties, theoretical and engineering problems on dynamic properties, and the development of a tentative method for load test on soils. A tentative method for load tests on piles is being studied which will cover only the test procedure with no effort being made to include the interpretation of the test results.

Industrial Water (D-19)

Included in the program of Committee D-19, specifically its Subcommittee III on Methods of Sampling, are revisions to Methods of Sampling Water for Industrial Uses (D 510), a new proposed Method for Sampling of Water at Subatmospheric Pressure and a study of comments supplied to the proposed Method for Sampling of Steam, published as information in the ASTM Bulletin, March, 1948. Reprints of the proposed method will be issued to the industry and comments are invited. This method is intended to supply a need for proper sampling of steam for the determination of steam quality—moisture in steam by the calorimeter method—and for steam purity, determined by either the electrical conductance method or by evaporation of the condensed steam, and the estimation of the residue secured.

The program of Subcommittee IV on Methods of Analysis includes the preparation of proposed Methods for Acidity and Alkalinity, Hardness, Alkali Metals, Sodium and Potassium, Chlorine and additional methods of nonreferee character for Carbon Dioxide and Nitrates. The Standard Methods for Phosphate (D 515), Sulfate (D 516), and Chlorides (D 512) are being studied for revisions.

(Continued on P. 46)

ASTM Bulletin

AUGUST 1948

NO. 153

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Numerous Actions on Standards Submitted to Members for Letter Vote

At the 1948 Annual Meeting in Detroit approval was given to submit to letter ballot of the Society proposals from the technical committees involving some 129 standards and tentatives. These proposals as listed on the letter ballot which will be mailed to the entire membership in August, fall into two categories, namely the adoption of tentative specifications and tests as formal standards, and the adoption of revisions in existing standards.

The letter ballot on the actions on standards will be canvassed on September 30.

In connection with the actions on standards it should be noted that only by letter ballot of the entire Society membership can changes be made in the formal standards. The action of an annual meeting session alone, or in the interval between annual meetings the Administrative Committee on Standards, can approve for publication as *tentative* proposed new standards, can approve *revisions in tentative standards* (which are incorporated immediately), or can take action to permit publication as *tentative* of *proposed revisions in standards*. Many such actions, of course, are taken at the Annual Meeting and throughout the year by the Administrative Committee on Standards.

A complete list of the items to be voted upon appears in the letter ballot being sent in a separate mailing to the members. Detailed information concerning most matters referred to letter ballot is given in the committee reports issued in preprint form to the membership in advance of the meeting. The *Summary of Proceedings* accompanying the letter ballot contains a record of all actions taken at the Annual Meeting.

All newly adopted and revised standards will be published in the 1948 Supplements to the 1946 Book of A.S.T.M. Standards. The Supplements will be in five parts corresponding to the Books of Standards, and the respective parts will be furnished to the members in accordance with the parts of the big 1946 Book which they have received or in line with instructions on file at Headquarters. In the meanwhile a number of the standards together with all new tentatives approved at the Annual Metting or through the Administrative Committee on Standards will be published in some of the special compilations of standards or as separates. Details of the Society's extensive publication schedule are given in another article in this Bulletin.

1949 National Meetings in Atlantic City, Chicago, and San Francisco

Decision has been reached by the Board of Directors to return to Atlantic City for the 1949 Annual Meeting, using Chalfonte-Haddon Hall as convention headquarters. This decision will please a large number of the members and committee members of the Society. All of the numerous meetings held at Atlantic City have been very successful. The dates are June 27–July 1, inclusive.

The 1949 Spring Meeting and A.S.T.M. Committee Week will be held in Chicago during the week beginning February 28. Reservations for meeting rooms and sleeping room requirements have been made at the Edgewater Beach Hotel, and the Chicago District will act as host during the week. The District Council has already discussed certain plans, and members will be posted of developments later on.

There will be no exhibit of testing apparatus in 1949, the policy in connection with these exhibits being to hold them every two years, and with one having been held in Detroit during the 1948 meeting, none is scheduled until 1950.

The Board of Directors is considering various cities in which to hold the 1950 Annual Meeting.

Announcement was made in the May Bulletin (page 30) of the first Pacific Coast meeting of the Society, this national meeting being scheduled for October 10–14, 1949, in San Francisco, with both the Northern California and the Southern California Districts cooperating. Technical sessions and meetings of various committees are being planned and there will be other features to be developed under the auspices of the local committee on arrangements.

Committees Making Substantial Contributions to Building Fund

As a result of activity in a number of the A.S.T.M. technical committees on raising of money for the A.S.T.M. Building Fund, a rather substantial amount in aggregate has been made to the fund, thus reducing the indebtedness on the building. About a year ago at the suggestion of certain officers of the Society, the technical committees were invited to contact their members in connection with the fund, and the accompanying list indicates those committees which thus far have made such contacts. Various methods were used; for the most part a building fund committee was appointed and this group contacted its fellow members by letter. In some cases action was taken at meetings, and other methods have been used.

At the present time the Society's total indebtedness on the building amounts to about $16,000. The total cost including grounds, the building, and the rather heavy cost of renovation and expansion totals close to $190,000, so that the Board of Directors is highly gratified at the progress that has been made. Of course, it is hoping that in the not too far distant future the building will be

owned free of encumbrance, and to that end any members and friends of the Society are cordially invited to contribute to the fund.

The building has now been occupied for something over two years and this period has added to the conviction that the decision of the officers and members to procure the building was a wise one in every way. The success in procuring the building and the substantial progress made in financing it is due to the efforts of a good many of our officers and members. By far the major portions of the contributions came from industrial companies whose support means so much in underwriting the Society's work, but many contributions came from individual members of the Society.

The following table does not include a list of several technical committees which have had sums contributed to them by their members even though these committees have not yet undertaken any planned effort. Several of the committee members grouped their contributions, earmarking certain amounts to the several groups in which they held memberships. In part that is reason for the "odd cents" appearing in connection with several of the amounts that follow.

LIST OF COMMITTEES WHICH HAVE UNDERTAKEN SPECIAL BUILDING FUND PROJECTS, AND AMOUNTS RAISED

A-3 on Cast Iron	$203.33
A-5 on Corrosion of Iron and Steel	120.36
B-1 on Wires for Electrical Conductors	198.65
B-5 on Copper and Copper Alloys, Cast and Wrought	122.00
B-6 on Die-Cast Metals and Alloys	544.58
B-8 on Electrodeposited Metallic Coatings	60.33
C-1 on Cement	930.00
C-2 on Magnesium Oxychloride Cements	100.00
C-7 on Lime	88.33
C-8 on Refractories	58.33
C-9 on Concrete and Concrete Aggregates	158.50
C-14 on Glass and Glass Products	110.00
C-16 on Thermal Insulating Materials	90.00
D-1 on Paint, Varnish, Lacquer, and Related Products	644.00
D-3 on Gaseous Fuels	10.00
D-4 on Road and Paving Materials	65.00
D-5 on Coal and Coke	236.34
D-7 on Wood	273.36
D-8 on Bituminous Waterproofing	66.36
D-10 on Shipping Containers	273.03
D-11 on Rubber and Rubber-Like Material	609.36
D-12 on Soaps and Other Detergents	184.00
D-14 on Adhesives	20.00
D-18 on Soils for Engineering Purposes	14.00
D-19 on Water for Industrial Uses	560.00
D-20 on Plastics	423.36
E-3 on Chemical Analysis of Metals	225.00
E-4 on Metallography	116.00
E-5 on Fire Tests of Materials and Constructions	122.36
E-6 on Methods of Testing Building Construction	26.36
Earmarked from other technical committees	$421.69
Grand total from all technical committees	$7074.63

September 15—Last Day for Annual Meeting Papers Discussion

MUCH of the discussion of technical papers and reports published in the *Proceedings* is submitted after the meeting "by letter." Written discussion of papers and reports presented at the 1948 Annual Meeting in Detroit will be received by the Committee on Papers and Publications until September 15. It will be greatly appreciated if all who plan to submit such discussion will do so well in advance of this date so that additional time is available for review and submission to authors for closure.

Schedule of A.S.T.M Meetings

DATE	GROUP	PLACE
August 18	New York District Council Meeting	New York City, N. Y.
September 9	Committee C-8 on Refractories	Conneaut Lake Park, Pa.
September 20, 21	Board of Directors	Philadelphia, Pa.
October 3	Committee D-3 on Gaseous Fuels	Atlantic City, N. J.
October 7, 8	Committee D-10 on Shipping Containers	Chicago, Ill.
October 11, 12	Committee C-16 on Thermal Insulating Materials	Atlantic City, N. J.
October 13	Philadelphia District	Franklin Institute Philadelphia, Pa.
October 13, 14	Committee B-8 on Electrodeposited Metallic Coatings	New York, N. Y.
October 13, 14, 15	Committee D-13 on Textile Materials	Washington, D. C.
October 14	Dinner and Technical Meeting, Washington (D. C.) District	Washington, D. C. (Wardman Park Hotel)
November 10	Philadelphia District President's Night (Aluminum)	Franklin Institute Philadelphia, Pa.
November 13, 14, 15, 16	Committee D-2 on Petrolem Products and Lubricants	Chicago, Ill. (Drake Hotel)
November 16, 17	Committee D-20 on Plastics	Atlantic City, N. J.
November 17, 18, 19	Committee D-9 on Electrical Insluating Materials	Atlantic City, N. J.
November 18, 19	Committee C-19 on Structural Sandwich Constructions	(A.S.T.M. Headquarters) Philadelphia, Pa.

RESOLUTION OF THE A.S.T.M. BOARD OF DIRECTORS

June, 1948

RESOLVED, that the Board of Directors of the American Society for Testing Materials notes with appreciation the splendid accomplishments of the Detroit Committee on Arrangements in planning and carrying through various functions and details of the Fifty-first Annual Meeting of the Society. The activities of the Committee contributed greatly to the success of the annual meeting. The Dinner and Dance and the various features of Ladies Entertainment, for which the Committee and the Hostess Committee were responsible, were outstanding events and will long be remembered by all who participated. Other important details of the meeting, including hotels, exhibits, plant visits and transportation, publicity and financing, were ably handled by the various subcommittees.

For all these services the Board of Directors, for itself and on behalf of the Society, extends its sincere thanks to the officers and members of the Detroit Committee on Arrangements.

DISTRICT ACTIVITIES

District Officers and Personnel

THE District Councils of the Society have conducted an election of officers and councilors for the ensuing term of two years, under the A.S.T.M. Charter for Districts, which has been in effect since January 1, 1947. This charter provides that councilors and officers shall be elected by the A.S.T.M. members and committee members in the respective districts. Ballots were distributed in May, and all councilors listed on the ballots on recommendation of the respective Nominating Committees were elected.

The list of officers and councilors is given below. Newly elected councilors are indicated by an asterisk (*). Terms of approximately one-half of the councilors expire each June.

Several of the districts have already planned fall meetings, and members are urged to watch the BULLETIN for specific dates and topics of meetings to be sponsored. During the past year several technical meetings sponsored by the districts have resulted in very interesting papers and publications.

As soon as possible after meeting details are definite, each member and committee member in the specific area receives a direct-mail notice, and usually other groups of technical men in the area concerned with the subject under discussion are also invited.

A complete list of district councilors will appear in the 1948 Year Book. Many of the councilors' terms carry through 1949, and the list below notes only newly elected councilors and officers and reelections of those whose terms expired in 1948.

List of New or Reelected District Councilors as of June, 1948

(For complete list see 1948 Year Book, now in preparation)

Chicago

Chairman: J. J. Kanter, Crane Co., 836 S. Michigan Ave., Chicago 5, Ill.; *Vice-Chairman:* J. de N. Macomb, Inland Steel Co. (Retired), 105 E. Delaware Place, Chicago 11, Ill.; *Secretary:* G. E. Stryker, Bell & Howell Co., 7100 McCormick Blvd., Chicago 45, Ill.

Councilors: C. E. Ambelang, Public Service Company of Northern Illinois; E. E. Chapman, Atchison, Topeka & Sante Fe Ry.; H. B. Emerson, Lehigh Portland Cement Co.; J. T. Jarman, Allis-Chalmers Manufacturing Co.; G. G. Lamb,* Northwestern Technological Institute; V. C. Mehlenbacher,* Swift and Company; C. A. Menzel, Portland Cement Association; H. G. Miller, Chicago, Milwaukee, St. Paul & Pacific Railroad Co.; H. H. Morgan, Robert W. Hunt Co.; F. A. Randall, F. A. Randall and Sons; M. N. States,* Central Scientific Co.

Cleveland

Chairman: A. J. Tuscany, Arthur J. Tuscany Organization, Trade Association and Management, 1006 Engineers Building, Cleveland 14, Ohio; *Vice-Chairman:* R. T. Bayless, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; *Secretary:* H. P. Ferguson, Standard Oil Co. Ohio, Midland Building, Cleveland 15, Ohio.

Councilors: J. S. Adelson,* Republic Steel Corp.; Arthur W. Carpenter, The B. F. Goodrich Co.; J. V. Emmons, The Cleveland Twist Drill Co.; K. H. Osborn, The Osborn Engineering Co.; J. M. Stadter, The Glidden Co.; F. G. Steinebach, Penton Publishing Co.; R. L. Wilson, Timken Roller Bearing Co.; George Yearley,* American Fork and Hoe Co.

Detroit

Chairman: F. P. Zimmerli, Barnes-Gibson-Raymond Div., Associated Spring Corp., 6400 Miller Ave., Detroit, 11, Mich.; *Vice Chairman:* C. E. Heussner, Chrysler Corp., 12800 Oakland Ave., Detroit 31, Mich.; *Secretary:* C. M. Gambrill, Research Labs., Ethyl Corp., 1600 W. Eight Mile Rd., Detroit 20, Mich.

Councilors: W. R. Frazer,* Michigan Consolidated Gas Co.; C. M. Gambrill, Ethyl Corp.; A. J. Herzig,* Climax Molybdenum Co. (of Mich.); D. M. McCutcheon,* Ford Motor Co.; C. A. Siebert,* University of Michigan; E. W. Upham, Chrysler Corp.; G. B. Watkins,* Libbey-Owens-Ford Glass Co.; H. R. Wolf,* General Motors Corp.

New England

Chairman: V. J. Altieri, Eastern Gas and Fuel Associates, Everett Plant, Everett 49, Mass.; *Vice-Chairman:* M. N. Clair, The Thompson and Lichtner Co., Inc., 8 Alton Place, Brookline 46, Mass.; *Secretary:* C. G. Lutts, U. S. Navy Materials Lab., U. S. Naval Shipyard, Boston 29, Mass.

Councilors: J. J. Allen, Firestone Rubber and Latex Products; E. N. Downing, Thomson Laboratory, General Electric Co.

New York

Chairman: Myron Park Davis, Otis Elevator Co., 44 Wells Ave., Yonkers 1, N. Y.; *Vice-Chairman:* E. A. Snyder, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.; *Secretary:* G. O. Hiers, National Lead Co., 105 York Street, Brooklyn 1, N. Y.

Councilors: A. G. Ashcroft,* Alexander Smith & Sons Carpet Co.; W. H. Bassett, Jr. (In Army Service), Anaconda Wire and Cable Co.; H. C. R. Carlson, The Carlson Co.; W. F. Collins,* New York Central System; H. G. Farmer, Universal Atlas Cement Co.; J. C. Fox, Doehler-Jarvis Corp.; Ephraim Freedman, R. H. Macy and Co.; C. T. Hatcher, Consolidated Edison Co. of New York, Inc.; E. P. Pitman, Port of New York Authority; C. H. Rose,* National Lead Co.; Gordon Thompson, Electrical Testing Labs., Inc.; J. R. Townsend,* Bell Telephone Labs., Inc.; J. S. Vanick,* The International Nickel Co., Inc.; R. M. Wilhelm, Miller and Weber.

Northern California

Chairman: Dozier Finley, Research Consultant, 2725 Ashby Place, Berkeley 5, Calif.; *Vice-Chairman:* G. H. Raitt, Steel Tank & Pipe Co. of Calif., Berkeley 2, Calif.; *Secretary:* P. V. Garin, Southern Pacific Co., 65 Market St., San Francisco 5, Calif.

Councilors: R. N. Conner,* The Baldwin Locomotive Works; H. A. Williams, Stanford University.

Philadelphia

Chairman: A. O. Schaefer, Midvale Co., Philadelphia 40, Pa.; *Vice-Chairman:* E. J. Albert, Thwing-Albert Instrument Co., Penn St. and Pulaski Ave., Philadelphia 44, Pa.; *Vice-Chairman:* E. K. Spring, Henry Disston & Sons, Inc., Unruh and Milnor Sts., Philadelphia 35, Pa.; *Secretary:* Tinius Olsen, 2nd, Tinius Olsen Testing Machine Co., Easton Road, Willow Grove, Pa.

Councilors: W. J. Diederichs,* The Autocar Co.; G. E. Doan,* Lehigh University; Henry Grinsfelder,* Resinous Products and Chemical Co., Inc.; H. M. Hancock, The Atlantic Refining Co.; E. O. Hausmann,* Continental-Diamond Fibre Co.; C. R. Hutchcroft,* Keasby and Mattison Co.; G. Y. Jean,* James Lees and Sons Co.; G. H. Mains, National Vulcanized Fibre Co.; R. B. Rohrer,* Armstrong Cork Co.; H. W. Stuart,* U. S. Pipe and Foundry Co.; J. F. Vogdes, Jr., Consulting Engineer; F. G. Tatnall Baldwin-Southwark Corp.

Pittsburgh

Chairman: J. J. Bowman, Aluminum Company of America, 801 Gulf Building, Pittsburgh 19, Pa.; *Vice-Chairman:* J. J. Paine, Chief Engineer of Tests, City of Pittsburgh, Centre Ave. and Dithridge St., Pittsburgh 13, Pa.; *Secretary:* M. D. Baker, West Penn Power Co., Box 98, Springdale, Pa.

Councilors: F. H. Allison, Jr.,* United Engineering and Foundry Co.; R. A. Biggs,* Pittsburgh-Corning Corp.; R. A. Frye,* Westinghouse Electric Corp.; H. F. Hebley,* Pittsburgh Coal Co.; Max Hecht, Adviser, Power Stations Chemistry; F. M. Howell, Aluminum Company of America; C. L. Kent,* Jones and Laughlin Steel Corp.; J. N. Roche,* Koppers Co., Inc.; Mary E. Warga, University of Pittsburgh; M. C. Wylie, Gulick-Henderson Co., Inc.

St. Louis

Chairman: J. C. Hostetter, Mississippi Glass Co., Main and Angelica Sts., St.

Louis 7, Mo.; *Vice-Chairman:* S. B. Roberts, Robert W. Hunt Co., 1403 Syndicate Trust Bldg., St. Louis 1, Mo.; *Secretary:* J. M. Wendling, City of St. Louis, Municipal Testing Lab., 55 Municipal Courts Bldg., St. Louis 3, Mo.

Councilors: E. J. Russell, Mauran, Russell, Crowell & Mullgardt; H. E. Wiedemann, Consulting Chemist.

Southern California

Chairman: C. E. Emmons, The Texas Company, 929 S. Broadway, Los Angeles 15, Calif.; *Vice-Chairman:* F. J. Converse, California Institute of Technology, 1201 E. California St., Pasadena 4, Calif.; *Secretary:* H. W. Jewell, Pacific Clay Products, 306 W. Ave. 26, Los Angeles 31, Calif.

Councilors: W. C. Hanna, California Portland Cement Co.; M. S. Mayo,* Textile Engineer; R. B. Stringfield, Consulting Chemical Engineer; J. T. Young,* Los Angeles Bureau of Standards.

Western New York-Ontario

Chairman: O. W. Ellis, Ontario Research Foundation, 43 Queen's Park, Toronto, Ont., Canada; *Vice-Chairman:* L. F. Hoyt, National Aniline Div., Allied Chemical & Dye Corp., Box 975, Buffalo 5, N. Y.; *Vice-Chairman:* L. V. Foster, Bausch & Lomb Optical Co., 635 St. Paul St., Rochester 2, N. Y.; *Secretary:* Joseph Gentile, Pittsburgh Testing Laboratory, 257 Franklin St., Buffalo 2, N. Y.

Councilors: J. F. Barton, Federal Portland Cement Co.; C. W. Georgi, Quaker State Oil Refining Co.; N. S. Grace, Dunlop Tire and Rubber Goods Co., Ltd.; R. A. Kundinger, Dominion Rubber Co.; I. C. Matthews, Eastman Kodak Co.; Alden Merrill, American Brass Co.; O. M. O'Neill, Niagara Alkali Co.; H. G. Swan, Symington-Gould Corp.; F. A. Webber,* Wickwire Spencer Steel Div., The Colorado Fuel and Iron Corp.

The complete personnel of the new Washington (D. C.) District Council was published in the January BULLETIN, page 11. In connection with the formal organization of the Lower Ohio Valley District, the Nominating Committee is organizing, and a slate of officers will be announced to the members in that area in the early fall, with the election being conducted by the Administrative Committee on District Activities.

A map showing the areas of the respective districts was published in the May BULLETIN, page 45, and there was a list of the approximate number of members and committee members in the respective districts. About 85 to 90 per cent of the membership in the United States is now included in the 13 districts that have been established.

Three Districts Hold Late Spring, Early Summer Meetings

New England, New York, and Western New York-Ontario Have Interesting Sessions

IN THE late spring three of the A.S.T.M. districts sponsored interesting and successful meetings which have not been noted in the ASTM BULLETIN, although they were listed in the complete table of meetings published as part of the Report of the Board of Directors.

Boston Meeting.—At the Boston meeting, held in one of the buildings of Northeastern University on Wednesday, April 14, 1948, President T. A. Boyd delivered his discussion on "Research—Everybody's Doing It!" and there were two prepared discussions, one by A. L. Shields, Materials and Process Engineer, Westinghouse Electric Corp., Springfield, Mass., on "Finding Answers to Materials Problems in Electrical Equipment," and the other by Professor A. G. H. Dietz, Department of Building Engineering and Construction and Director, Plastics Research Laboratory, Massachusetts Institute of Technology, Cambridge, Mass., on "Finding Answers to Materials Problems in the Plastics Field." While attendance was low because of inclement weather, those present felt well repaid for the necessary exposure to the elements. Arrangements for this meeting were handled by the New England District Officers, H. L. Sherman, Chairman; V. J. Altieri, Vice-Chairman; M. N. Clair, Secretary; with Professor W. C. Voss arranging the program.

New York Meeting.—The session sponsored by the New York District at the Engineering Societies Building on April 13, 1948, was another in the series of rather unusual meetings which this group has sponsored, each of which has been very successful. The subject was "Weather, of Vital Interest to Ma, Pa, and the Kids, to Farms and Industry." The two principal speakers were V. J. Schaefer, Research Assistant in Chemistry, Physical Studies Section Research Laboratories, General Electric Co., Schenectady, N. Y., whose topic was "Modification of Clouds in the Free Atmosphere," and P. E. Kraught, Supervisor of Meteorology, American Air Lines, LaGuardia Field, New York, who spoke on "Margin of Error in Weather Forecasts." A. A. Jones, Anaconda Wire and Cable Co., acted for the New York District in securing the speakers and setting up the general program, under the main program committee headed by C. H. Rose, National Lead Co. Myron Park Davis, Otis Elevator Co.; District Chairman; E. A. Snyder, Socony-Vacuum Oil Co., Inc., District Vice-Chairman; and G. O. Hiers, National Lead Co., District Secretary, also had a part in planning the meeting.

Western New York-Ontario Meeting.—The very successful meeting had been planned for some time by the Western New York-Ontario District officers, T. L. Mayer, Buffalo Public Library, Chairman; O. W. Ellis, Ontario Research Foundation, Vice-Chairman; and Joseph Gentile, Pittsburgh Testing Laboratory, Secretary. The meeting was a joint one with the Niagara Peninsula Branch of the Engineering Institute of Canada, and Mr. R. A. Coombes, English Electric Co. of Canada, Ltd., Vice-Chairman of the E. I. C.; together with J. J. Miller, Niagara, St. Catharines & Toronto R. R., Secretary; and M. F. Ker, Stamford Township Engineer, Chairman, aided in setting up the meeting.

The speaker, Dr. R. B. Gordon, Manager, Metallurgical Development Section, Westinghouse Electric Corp., Pittsburgh, Pa., gave a most interesting talk with numerous excellent slides on the broad subject of "Materials for Gas Turbines," and the more than 110 present certainly received a very basic and detailed knowledge on just what materials engineers have been able to develop to meet some of the rigorous requirements of gas turbine operation.

This meeting was held at the Red Casque Inn, three miles north of Niagara Falls, Ontario, and is the second meeting which this A.S.T.M. district has held with a Canadian group, the first one having been held in May, 1944, in Toronto with the Affiliated Engineering and Allied Societies in Ontario, of which Dr. O. W. Ellis was President.

TECHNICAL COMMITTEE NOTES

Joint Committee Requests Data on High-Temperature and Low-Temperature Testing Equipment

In 1940, the A.S.T.M.-A.S.M.E. Joint Committee on Effect of Temperature on the properties of Metals conducted a detailed survey of the high-temperature testing equipment in this country. During the recent war, the results of this survey were found to be of considerable aid to Government agencies in setting up correlated research programs on high-temperature problems. Considerable expansion of these facilities has occurred during the past eight years, rendering the original survey obsolete. The Joint Committee is therefore undertaking a revision of this survey, which is to include low-temperature as well as high-temperature testing facilities. A summary of the survey will be published in the *Proceedings* of the Society as a part of the annual report of the Joint Committee.

The Joint Committee has distributed to many of the laboratories in this country a sample data sheet and details of types of testing equipment on which information is desired. Since the committee is anxious that the survey be as complete as possible, any laboratories which have facilities for studying temperature effects, and who have not received this material from the Committee, are urged to write A.S.T.M. Headquarters for copies of the information. All replies will be referred to Mr. R. F. Miller who is the Chairman of the Section responsible for assembling the data.

Sectional Committee Preparing New and Revised Pipe Standard

A new standard for stainless steel pipe and revisions of the existing Basic Standard B36.10 for standard pipe are in process of completion through the work of the Sectional Committee on Standardization of Wrought-Iron and Wrought-Steel Pipe and Tubing functioning under the procedure of the American Standards Association. This committee, carrying the designation B36, is sponsored jointly by the A.S.T.M. and The American Society of Mechanical Engineers.

At meetings of the committee held in recent months considerable progress has been made and it is anticipated in the early fall the two standards will be approved for reference to letter ballot.

Serving on this sectional committee are representatives of leading associations and groups concerned with the production and use of all kinds of pipe. The work of the committee is particularly important in setting up schedules of pipe sizes, weights, thicknesses, etc. in the interest of simplification and ease of ordering.

The new committee officers, who have been functioning since the committee held its first meeting in many years late in 1947, are as follows: *Chairman*, J. J. Kanter, Crane Co.; *Vice-Chairman*, J. Roy Tanner, Tanner & Arnold; *Secretary*, L. W. Kattelle, Walworth Co. Mr. Tanner has been serving as chairman of a special section working on a revision of the Basic Standard B36.10, and J. J. B. Rutherford, Babcock & Wilcox Tube Co., has been heading up the group working on the stainless steel pipe standard.

New Subcommittee on Water-borne Industrial Wastes

Committee D-19 on Industrial Water has recently formed a new subcommittee known as Subcommittee VII on Water-borne Industrial Wastes. The scope of this subcommittee comprises the preparation of standard methods for sampling of water-borne industrial wastes, the preservation and analysis of samples, and the methods of reporting the results of such analysis.

The scope of the activity of the subcommittee will be restricted to wastes developing or being produced in an industrial plant, thus analysis and procedures apply only to intake and outfall water together with various process steps in the plant.

Present-day trends are definitely in the direction of every industry keeping its own house in order and disposing of its own refuse rather than dumping it on its neighbor as in the case with many water-borne wastes. Many laws and regulations are being enacted to prevent ruthless dumping of such refuse. Certain difficulties arise in attempting to formulate these laws and regulations since deleterious amounts may not be definitely known as there is no accepted method by which to determine them. Thus since the restrictor desires to be fair with his clientele, the regulation may be written in a manner devoid of method of determinations or permissible amount by any specific method and hence ambiguous and difficult to enforce. Also the restrictor may draw from the hat a specification which places an extreme hardship upon the producer since its requirements are altogether too restrictive or based on poor methods of determination.

The facts thus stated have caused D-19 on Industrial Waters to consider this problem. Investigation shows that most methods for water analysis now recognized are applicable only to potable water, boiler water, or household sewage and cannot be applied to waters carrying concentrations of normal industrial wastes. It is intended then to obtain or develop methods which may be standard methods for the guidance of all concerned with these problems.

This matter is being brought to the attention of the membership as a whole in the belief that there may be members of committees other than Committee D-19 who may be interested in this subject. The chairman of the new subcommittee, L. Drew Betz, General Manager, W. H. & L. D. Betz, Philadelphia, is actively seeking the names of all members interested in this subject. If the matter is of interest to you, you are requested to forward your name and address to Headquarters.

Tested Samples Desired for Studies on Thermal Conductivity of Insulating Fire Brick

Although Committee C-8 on Refractories has a standard method for determining the thermal conductivity of insulating fire brick, a relatively simple alternate method is being investigated. This is the result of the work of Dr. H. C. Dickinson and his associates at the National Bureau of Standards, Washington, D. C. Their equipment and procedure have been developed to the place where a comparison is to be made of the data ob-

tained by the new method and established procedures. Dr. Dickinson would therefore appreciate receiving samples of insulating fire brick on which the thermal conductivity has been determined by established methods, so that these materials can be retested to obtain the necessary information. Those who can cooperate in the project should correspond with Dr. Dickinson for further details. Much of the success in investigating the new method will depend upon the cooperation.

Committee C-21 on Whitewares

A NEW Committee on Whitewares has recently been authorized by the Board of Directors, which committee will work in cooperation with the existing white wares division of the American Ceramic Society much in the manner that our Committee C-8 on Refractories is cooperating with the American Ceramic Society in the refractories field. The scope of the committee is expected to include all types of whitewares including sanitary ware, electrical porcelain, laboratory porcelain, stoneware, dinnerware, and ceramic tile.

The personnel is now being assembled to include not only representatives of manufacturers and users of the products but also suppliers of the basic materials. The early activity of the committee will no doubt deal for the most part with methods of test. The work of this committee should be of interest to a number of A.S.T.M. members.

New Committee on Appearance

STEPS are now being taken looking toward the early organization of a new Technical Committee on Appearance. So many committees of the Society are interested in various phases of the subject that there has been need for a central coordinating agency to whom all of the other technical committees might turn for expert advice on the subject. A new technical committee accordingly has been authorized by the Board and the following tentative statement of scope has been assigned:

"To improve and develop methods for describing and evaluating the appearance properties (such as color, gloss, opacity, and texture) of engineering materials by:

1. Formulating terms and definitions generally applicable for describing the appearance of engineering materials.
2. Developing, or coordinating with technical committees the development of, standard methods of measurement of fundamental and broadly general appearance properties.
3. Assisting the technical committees to improve appearance tests by advice and suggestions.
4. Reviewing and recommending approval or revision of all A.S.T.M. methods of testing, existing or proposed, involving appearance factors.
5. Serving, with the approval of the Board of Directors, as liaison agent between the Society and other organizations in matters concerned with factors of appearance."

It is expected that an organization meeting will be held some time this fall. M. Rea Paul, Frederic H. Rahr, Inc., has been designated temporary chairman to effect organization and the personnel is now being assembled.

New Technical Committee on Structural Sandwich Constructions—Committee C-19 Organizes

AN INTERESTING expansion in the field of engineering materials covered by the Society is represented in the organization of Committee C-19 on Structural Sandwich Constructions. The organization meeting of this new committee was held at A.S.T.M. Headquarters on January 30. An attendance of 30 representatives of producer and nonproducer interests in this field gave evidence of the interest in this new activity of the Society. Considerable discussion revolved around a proper statement of scope upon which the committee would base its activities. It was realized that the scope in turn would be influenced by an acceptable definition of the term "structural sandwich construction." A tentative definition now being considered is as follows:

"Structural Sandwich Construction is a laminar construction comprising a combination of alternating dissimilar simple or composite materials assembled and intimately fixed in relation to each other so as to use the properties of each to attain specific structural advantages for the whole assembly."

Numerous structural sandwich constructions have been developed, many of which are well known to engineers. These usually include dense materials as the faces, involving metal or plastics or some related substance, between which faces will be found a light-weight porous or expanded material such as balsa wood, cellular plastic construction, etc.

A joint meeting of the Advisory and the By-laws Subcommittees was held on March 3 during A.S.T.M. Committee Week in Washington, D. C., at which time plans were made for a full dress meeting of the committee during the Annual Meeting in Detroit. Initial consideration was also given to the proposed By-laws.

Four subcommittees have been formed and are already actively pursuing their work. The new committee with all subcommittees met in Detroit on June 21, at which time the By-laws were adopted, subject to letter ballot, which include an approved scope under which the committee plans to now operate. The scope reads as follows:

SCOPE: The development of test methods and specifications applicable to structural sandwich constructions. Test methods and specifications on basic materials, as covered by other committees, shall be used when applicable.

Subcommittee I on Mechanical Properties of Basic Materials (R. C. Platow, Chairman) in its initial program will consider only those core materials not covered at present by other A.S.T.M. committees, and will establish a data sheet on the properties of core as well as face materials.

Subcommittee II on Mechanical Properties of Basic Sandwich Construction (E. W. Kuenzi, Chairman) has established several sections to which will be allocated for study the various types of tests on sandwich constructions deemed advisable for consideration.

Subcommittee III on Permanence, Durability, and Simulated Service (D. G. Reid, Chairman) will operate at present with one section on exposure facilities and six sections on end use requirements.

Subcommittee IV on Nomenclature and Definitions (J. M. Stevens, Chairman) has reached general agreement on a definition for "structural sandwich constructions," noted above, which together with other definitions of terms will be circulated for further comment.

A Subcommittee on Research has now been authorized as a result of the Detroit meetings.

The temporary officers of the new committee are: *Chairman*, A. G. H. Dietz; *Vice-Chairman*, D. G. Reid; and *Secretary*, E. C. Hartmann. The Ad-

visory Subcommittee consists of the officers, subcommittee chairmen, and the following members-at-large: R. B. Crepps, L. J. Markwardt, and R. C. Platow. The initial membership list is noted below.

The committee expects to hold its next meeting at A.S.T.M. Headquarters on November 18 and 19.

INITIAL MEMBERSHIP OF COMMITTEE C-19 ON STRUCTURAL SANDWICH CONSTRUCTIONS

Temporary Chairman: A. G. H. Dietz, Massachusetts Institute of Technology
Temporary Vice-Chairman: D. G. Reid, Chance Vought Aircraft Division of United Aircraft Corp.
Temporary Secretary: E. C. Hartmann, Aluminum Research Laboratories, Aluminum Company of America

Aluminum Company of America, E. C. Hartmann
American Structural Products Co., E. C. Shuman
Baldwin Locomotive Works, F. G. Tatnall
Bell Telephone Laboratories, Inc., R. C. Platow
The Celotex Corp., B. A. Savage and W. B. Waterfall
Chance Vought Aircraft Division of United Aircraft Corp., D. G. Reid
Chrysler Corp., John Bidek and M. F. Rankin
Civil Aeronautics Administration, Stanley Yagiela
Committee B-7 on Light Metals and Alloys, Cast and Wrought, R. B. Smith
Committee D-7 on Wood, J. A. Liska
Committee D-11 on Rubber and Rubber-Like Materials, Simon Collier
Committee D-14 on Adhesives, A. G. H. Dietz and R. C. Platow
Committee D-20 on Plastics, R. H. Witt
Committee E-6 on Methods of Testing Building Constructions, K. F. Wendt
A. G. H. Dietz, Massachusetts Institute of Technology
The Dow Chemical Co., J. W. Everson
E. I. du Pont de Nemours and Co., Inc., H. W. Paine
Armin Elmendorf, The Elmendorf Corp.
Goodyear Tire & Rubber Co., Aircraft Division, O. W. Loudenslager
Haskelite Manufacturing Corp., J. H. Tigelaar
Hercules Powder Co., H. C. Malpass
Johns-Manville Corp., S. E. Williams
K. W. Kruger, U. S. Forest Products Laboratory
E. W. Kuenzi, U. S. Forest Products Laboratory
L. J. Markwardt, U. S. Forest Products Laboratory
The Glenn L. Martin Co., S. A. Gordon and T. P. Pajak
R. A. Miller, Consolidated Vultee Aircraft Corp.
National Bureau of Standards, B. M. Axilrod and J. J. Lamb
N. M. Newmark, University of Illinois
North American Aviation, Inc., G. R. Huisman
Owens-Corning Fiberglas Corp., R. B. Crepps, J. H. Gibbud, and Harold Perrine
Pittsburgh Corning Corp., R. A. Biggs
Plaskon Division, Libbey-Owens-Ford Glass Co., M. H. Bigelow and C. E. Britt
Polytechnic Institute of Brooklyn, Department of Aeronautical Engineering and Applied Mechanics, B. A. Boley and H. F. Mark
G. M. Rapp, John B. Pierce Foundation
F. W. Reinhart, National Bureau of Standards
The Resinous Products and Chemical Co., Inc., R. E. Pflaumer
Reynolds Metal Co., R. B. Smith
U. S. Department of the Air Forces, R. T. Schwartz
U. S. Department of the Navy, Bureau of Aeronautics, L. B. Hutchinson, J. A. Roy and J. M. Stevens
U. S. Department of the Navy, Bureau of Ships, Code 350
United States Plywood Corp., C. B. Hemming
R. K. Witt, Johns Hopkins University

Symbols and Nomenclature for Fatigue Testing

THOSE who follow the activities of our various technical committees as reported in the BULLETIN will know that Committee E-9 on Fatigue is currently working on a Manual for Fatigue Testing which should be completed late this year or early next.

One chapter of this Manual will deal with the nomenclature and symbols used in fatigue testing. As this is such an important subject it has been felt desirable to publish the proposed text of this chapter in the BULLETIN so that it may be reviewed by the members of the Society at large and constructive comment or criticism which they may wish to make can be transmitted to the committee for consideration before the Manual is printed. Such discussion may be sent directly to Mr. J. M. Lessells of Lessells and Associates, 916 Commonwealth Ave., Boston 15, Mass., or can be sent to A.S.T.M. Headquarters for transmittal to the committee.

PART I.—SYMBOLS USED IN FATIGUE TESTING

The American Standard Letter Symbols for Mechanics of Solid Bodies (ASA No.: Z10.3-1942)[1] are recommended. For stress, the use of S with appropriate subscripts is preferred for general purposes. The Greek symbols are generally preferred for mathematical analysis.

SYMBOL	TERM
A	Area of cross-section
C	Cycle ratio
c	Distance from centroid to outermost fiber
D or d	Diameters
f	Frequency
I	Moment of inertia
J	Polar moment of inertia
K	Stress concentration or strength reduction factor with suitable subscript
n or N	Number of cycles
P or W	Load
q	Notch sensitivity
R	Stress ratio
S or σ	Stress, normal
S_s or τ	Stress, shear
T	Torque
t	Time
t or θ	Temperature[2]
ω	Circular frequency $= 2\pi f$

PART II.—NOMENCLATURE FOR FATIGUE TESTING[3]

Stress Cycle.—A stress cycle is the smallest section of the stress-time

Fig. 1.

[1] Obtainable from the American Standards Association, 70 E. 45th St., New York 17, N. Y. (.30 cents per copy).
[2] Use θ for temperature where time, t, is also used.
[3] The nomenclature given here refers to tensile and compressive stresses but is also applicable to shear stresses.

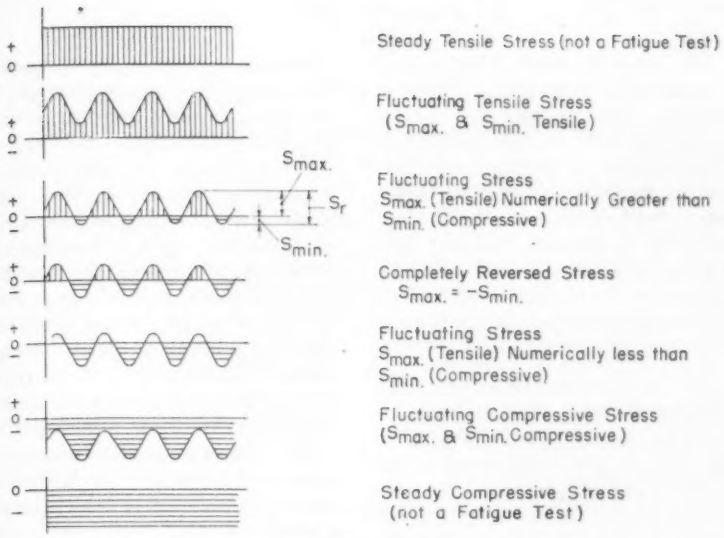


Fig. 2.

function which is repeated periodically and identically as shown in Fig. 1.

Nominal Stress, S.—The stress calculated on the net section by simple theory such as $S = P/A$ or $S = Mc/I$ or $S_s = Tc/J$ without taking into account the variation in stress conditions caused by geometrical discontinuities such as holes, grooves, fillets, etc.

Maximum Stress, $S_{max.}$—The highest algebraic value of the stress in the stress cycle, tensile stress being considered positive and compressive stress negative.

Minimum Stress, $S_{min.}$—The lowest algebraic value of the stress in the stress cycle, tensile stress being considered positive and compressive stress negative.

Range of Stress S_r.—The algebraic difference between the maximum and minimum stress in one cycle, that is, $S_r = S_{max.} - S_{min.}$ For most cases of fatigue testing the stress varies about zero stress but other types of variation may be experienced as shown in Fig. 2.

Alternating Stress Amplitude (or Variable Stress Component), S_a.—One half the range of stress, that is, $S_a = S_r/2$.

Mean Stress (or Steady Stress Component), S_m.—The algebraic mean of the maximum and minimum stress in one cycle, that is, $S_m = (S_{max.} + S_{min.})/2$.

Stress Ratio, R.—The algebraic ratio of the minimum stress and the maximum stress is one cycle, that is, $R = S_{min.}/S_{max.}$

Stress Cycles Endured, n.—The number of cycles which a specimen has endured at any stage of a fatigue test.

Fatigue Life, N.—The number of stress cycles which can be sustained for a given test condition.

Cycle Ratio, C.—The ratio of the stress cycles applied at a given stress level to the expected fatigue life at that stress level based on the S-N diagram, that is, $C = n/N$.

S-N Diagram.—A plot of stress against number of cycles to failure. It is usually plotted S *versus* log N, but a plot of log S *versus* log N is sometimes used.

Fatigue Limit (or Endurance Limit[4]), S_e.—The limiting value of the stress below which a material can presumably endure an infinite number of stress cycles; that is, the stress at which the S-N diagram becomes horizontal and appears to remain so. It should be noted that certain materials and environment preclude the attainment of a fatigue limit.

If the stress is not completely reversed, it is necessary to state what is meant by the fatigue limit. It may be expressed in terms of the alternating stress amplitude or the maximum stress but it is also necessary to state the value of the mean stress, minimum stress, or stress ratio.

Fatigue Strength,[5] S_n.—The greatest stress which can be sustained for a given number of stress cycles without fracture. The number of cycles should always be given. The same considerations as given under *Fatigue Limit* should apply where the mean stress is not zero.

Fatigue Ratio (or Endurance Ratio[6]). The ratio of the fatigue limit (or endurance limit), S_e, or fatigue strength, S_n, to the static tensile strength, S_u, that is, S_e/S_u or S_n/S_u.

Stress Concentration Factor, K_t.—The ratio of the greatest stress in the region of a notch or other stress concentrator as determined by advanced theory, photoelasticity, or direct measurement of elastic strain, to the corresponding nominal stress.

Fatigue Strength Reduction Factor,[7] K_f.—The ratio of the fatigue strength of a member or specimen with no stress concentration to the fatigue strength with stress concentration. K_f has no meaning unless the geometry, size, and material of the member or specimen and stress range are stated.

Notch Sensitivity, q.—A measure of the degree of agreement between K_f and K_t for a particular specimen or member of given size and material containing a stress concentrator of given size and shape. Thus: $q = (K_f - 1)/(K_t - 1)$. Notch sensitivity varies between zero (where $K_f = 1$) and unity (where $K_f = K_t$).

[4] "Fatigue limit" is considered preferable.

[5] "Fatigue strength" may also be considered to be a preferred general term, of which "fatigue limit" is a special case.

[6] Fatigue ratio is considered preferable.

[7] In some cases an author may like to use a shorter term, "fatigue notch factor."

Report on International Soil Congress

THE Second International Conference on Soil Mechanics and Foundation Engineering and the International Conference for Underground Town Planning was officially opened by Dr. Ir. W. J. H. Harmsen, Representative of The Netherlands Government at the City Theatre, Rotterdam, on June 22, 1948.

Technical sessions of the Soil Mechanics Conference were held at the Palace Theatre, Rotterdam. The total membership of the conferences was 591, and that of the American delegation was 38. In the absence of P. C. Rutledge, Chairman of the U. S. National Committee on Soil Mechanics, T. A. Middlebrooks, Vice-Chairman, acted as chairman. The U. S. Engineers, The Bureau of Reclamation, many universities, engineering and educational societies were

represented. A.S.T.M. was officially represented by E. J. Kilcawley, Rensselaer Polytechnic Institute, Chairman of A.S.T.M. Committee D-18 on Soils for Engineering Purposes, and Frederick J. Converse, California Institute of Technology, Vice-Chairman of D-18. Certain representatives of the U. S. Engineers were also designated as representatives of the State Department. It is believed that this is the first time that any engineering delegation has received the recognition of the Department of State.

Two technical sessions were held each day. In general each consisted of the presentation of a paper which was followed by a meeting of certain sections of the conference such as earth pressure and ground water or pile and raft foundations. The afternoon sessions were followed by visits to Delft Laboratories, the official reception by the Burgomaster of Rotterdam and the reception by the Government of The Hague.

Among the outstanding papers presented were:

Geology of The Netherlands, by T. K. Huizinga
Closing of Gaps in the Dykes of Walcheren by Prof. Ir. P. Ph. Jansen
Harbour Reconstruction at Rotterdam, by Ir. D. H. deHerder
The Construction of the Maastunnel, by Ir. J. P. van Bruggen

These and other papers represented the work of the Dutch engineers in solving the unique problems in Holland where a continuous fight to control water must be carried on.

Following the closing of the technical sessions on Saturday, tours were arranged for inspection of the tunnels under the Maas River at Rotterdam, of the canals, harbor, and airport at Armsterdam, the polders of North Holland, the dyke closing the Zuider Zee and of the harbor at Rotterdam. The damage to harbor facilities at both Rotterdam and Amsterdam was tremendous. It is remarkable and the Dutch are to be congratulated upon the great amount of reconstruction that has been accomplished since the liberation.

In the concluding remarks, Dr. Terzaghi pointed out that, in the old days, only judgment was available as a guide or tool in the solution of earth work and foundation problems. It was then assumed that foundations would not settle and that cuts could be made with little or no resulting settlement. If in either case settlement did occur, it was then considered an Act of God. Soil mechanics has changed this. It has furnished detailed information on both the magnitude and the rate of settlement and has provided a means of studying stress and strain in soils together with methods of study of cohesive soils.

Prior to the first conference held at Harvard in 1936, there was no opportunity for correlation of studies by an interchange of ideas. This conference was organized on an international basis. The skill and effort of the organizers cannot be too highly praised. However, these efforts were at least in part repaid by the exceptional high character of the papers which were prepared for the conference and which will be printed in the Proceedings. Much credit is due Ir. J. P. van Bruggen and Ir. T. K. Huizinga, chairman and secretary respectively of the committee on organization, for the exceptional job done on the organization and conducting of the conference.

At the closing business session of the conference, articles for the establishment and governing of the permanent international organization were adopted. Provision is made to cover activity between conferences by the requirement of a yearly report by the chairman of each national committee. The national committee members named for this conference are to form the nucleus of the permanent national committee.

The time and place of meeting of the next conference will be decided by the executive committee which consists of one representative from each country.

Copies of the Proceedings may be obtained by addressing Ir. T. K. Huizinga, Director, Laboratories of Soil Mechanics, Delft, The Netherlands. The cost is $30.

I feel sure that I may speak for each member of the American delegation in expressing our sincere thanks to the Dutch, first for the gracious welcome to Holland, for the continuous courtesies shown, for the excellent papers presented, and finally for pleasant and instructive tours arranged for all members of the conference.

For members of the conference who visited London after leaving Holland, the British National Committee on Soil Mechanics arranged two days of tours to visit The British Building and Road Research Centers, the laboratories at London University, at Soil Mechanics, Ltd. and at George Whimpy Co., Ltd., London.

E. J. KILCAWLEY

Foundation of the Eugene C. Bingham Memorial Award in Rheology—Annual Meeting of the Society of Rheology, November 5–6

THE Society of Rheology, at its November, 1946, meeting, voted to establish an Annual Award in Rheology in memory of the Society's founder, the late Professor E. C. Bingham.

Professor Bingham was also active in A.S.T.M. and made many contributions from his knowledge of the science of rheology. He rendered notable service to Committee E-1 on Methods of Testing and for the 20 years prior to his death he served as chairman of the E-1 Technical Committee II on Consistency, Plasticity, and Related Properties.

The Award will be made to a scientist living in the United States or Canada who, in the opinion of the Award Committee, has made the most outstanding contribution to the science of rheology. During 1947 the necessary funds were obtained to establish a perpetuating award in the form of a bronze medal bearing Prof. Bingham's likeness, the insignia of the Society, the recipient's name, and the award date. Later in that year, a sculptor, Mr. Charles Bradley Warren of Pittsburgh, was commissioned to design the medal.

The first presentation of the Award will be made on Friday, November 5, the opening day of the 1948 Annual Meeting. The chairman of the Award Committee is Dr. Henry A. Barton, Director of the American Institute of Physics. Other members are Dr. Turner Alfrey, Jr., Polytechnic Institute of Brooklyn; Dr. J. H. Dillon, Princeton University; Dr. R. B. Dow Navy Department; Dr. H. M. Spurlin, Hercules Powder Co.; Dr. R. N. Traxler, The Texas Company.

A number of leading companies, together with Mrs. Bingham, made the Award possible by their contributions.

The Annual Meeting of The Society of Rheology will be held on November 5 and 6 at the Hotel Pennsylvania, New York, N. Y. Technical Program Chairman is Dr. R. S. Spencer, The Dow Chemical Co. Arrangements and Social Evening Program are being made by A. G. Lynch and W. R. Willetts, Titanium Pigment Corp. Hotel room reservation cards and program announcements will be sent to members this month. Nonmembers can receive them by writing to the American Institute of Physics, 57 E. 55th St., New York, 22.

Close Relations Between American Ceramic Society and A.S.T.M. Through Committee on Refactories

Down through the years of its existence, the A.S.T.M. has had close contacts and very cordial relations with many of the country's scientific and professional associations and groups. It is to be expected that many of the A.S.T.M. members and committee members would participate not only in our work involving standardization and research, but also in the work of the professional societies and the technical groups which may be active in their respective industrial fields.

A notable example where such relations exist is the American Ceramic Society and the A.S.T.M., particularly through the membership of Committee C-8 on Refractories. After reviewing a list of past presidents of the Ceramic Society, one might almost conclude that Committee C-8 is a cradle of American Ceramic Society presidents. In addition to the current Committee C-8 Chairman, J. D. Sullivan, of Battelle Memorial Institute, who is now the immediate past president of the American Ceramic Society, the new president who took office on April 28 is J. W. Whittemore, active member of Committee C-8 and other A.S.T.M. groups, and the Vice-President is H. N. Kraner. Other Ceramic Society past presidents who are active members of the Committee include the following: C. E. Bales, G. A. Bole, M. C. Booze, J. L. Carruthers, R. B. Sosman, and L. J. Trostel. Mr. Trostel is now a member of the A.S.T.M. Board of Directors.

There is a further most interesting fact in connection with the affiliations of the members of Committee C-8—based on a check made about a year ago, every member of the committee was also a member of the American Ceramic Society.

Undoubtedly some of the other A.S.T.M. technical committees have somewhat similar relations to the professional and trade groups which serve their particular field, but we doubt very much whether any can surpass Committee C-8 in its close tie-in with the Ceramic Society.

The Refractories Division of the American Ceramic Society looks to Committee C-8 as its test committee of this particular division.

The committee has an enviable record of accomplishments. Its latest sponsored edition of the Manual of A.S.T.M. Standards on Refractories has just been issued, and the committee's work redounds to the credit of the A.S.T.M. and the American Ceramic Society.

Personnel of Board of Directors and Committees

The By-laws of the Society provide that the Board of Directors shall appoint an Executive Committee which will exercise for the Board certain delegated authorities, and provision is made also for the appointment of other committees of the Board covering such phases of the work as membership, inter-society relations, etc. The personnel of the new Executive Committee functioning during 1948–1949 and the six other subcommittees which have been appointed is given below. Preceding this information there is published a complete list of the personnel of the Board of Directors with the titles and addresses of the Directors.

A.S.T.M. Board of Directors

President:

R. L. Templin, Asst. Director of Research and Chief Engr. of Tests, Aluminum Company of America, New Kensington, Pa.

Vice-Presidents:

J. G. Morrow, Metallurgical Engineer, The Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

L. J. Markwardt, Asst. Director, U. S. Forest Products Laboratory, Madison 5, Wis.

Directors:

(Term Expiring in 1949)

A. G. Ashcroft, Director of Research, Alex. Smith and Sons Carpet Co., Yonkers 1, N. Y.

J. H. Foote, Supervising Engineer, The Commonwealth and Southern Corp., 212 W. Michigan Ave., Jackson, Mich.

G. C. MacDonald, Manager, Quality Control Group, Montgomery Ward and Co., 618 W. Chicago Ave., Chicago 7, Ill.

F. E. Richart, Research Professor of Engineering Materials, University of Illinois, Urbana, Ill.

L. H. Winkler, Metallurgical Engineer, Bethlehem Steel Co., Inc., Bethlehem, Pa.

(Term Expiring in 1950)

T. S. Fuller, Engineer in Charge of Works Laboratory, General Electric Co., Schenectady 5, N. Y.

E. G. Ham, Technical Director, John A. Manning Paper Co., Inc., Troy, N. Y.

J. J. Laudig, Research Engineer, Delaware, Lackawanna & Western Railroad Co., Scranton 5, Pa.

H. L. Maxwell, Supervisor of General Consultants, E. I. du Pont de Nemours and Co., Inc., 9539 Nemours Building, Wilmington 98, Del.

L. J. Trostel, Manager of Research Labs., General Refractories Co. Laboratories, Box 1673, Baltimore 3, Md.

(Term Expiring in 1951)

L. C. Beard, Jr., Chemist, Socony-Vacuum Oil Co., Inc., 26 Broadway, New York 4, N. Y.

S. Collier, Director of Quality, Johns-Manville Corp., 22 E. Fortieth St., New York 16, N. Y.

T. P. Dresser, Jr., Chief Engineer, Abbot A. Hanks, Inc., 624 Sacramento St., San Francisco 11, Calif.

E. W. Fasig, General Superintendent, Lowe Brothers Co., 424 E. Third St., Dayton 2, Ohio.

H. K. Nason, Associate Director, Central Research Dept., Monsanto Chemical Co., Dayton 7, Ohio.

Past-Presidents:

J. R. Townsend, Materials Engineer, Bell Telephone Laboratories, Murray Hill, N. J. (Term Expiring in 1949)

A. W. Carpenter, Manager of Testing Labs., The B. F. Goodrich Co., Akron 11, Ohio. (Term Expiring in 1950)

T. A. Boyd, Research Consultant, Research Laboratories Div., General Motors Corp., Box 188, North End Station, Detroit 2, Mich. (Term Expiring in 1951)

Committees of Board of Directors
1948–1949

Executive Committee

J. G. Morrow, *Chairman*

T. A. Boyd	H. L. Maxwell
S. Collier	F. E. Richart
R. L. Templin	

Finance Committee

J. R. Townsend, *Chairman*

T. A. Boyd	J. H. Foote
A. W. Carpenter	J. G. Morrow

Membership Committee

E. G. Ham, *Chairman*

T. P. Dresser, Jr.	G. C. MacDonald
E. W. Fasig	L. J. Trostel

Meetings and Program

T. S. Fuller, *Chairman*

L. C. Beard, Jr.	H. K. Nason
G. C. MacDonald	L. H. Winkler

Technical Committee Activities

L. H. Winkler, *Chairman*

J. J. Laudig	H. K. Nason
H. L. Maxwell	F. E. Richart

Inter-Society Relations

L. J. Markwardt, *Chairman*

L. C. Beard, Jr.	J. H. Foote
E. W. Fasig	L. J. Trostel

Developmental Activities

A. G. Ashcroft, *Chairman*

S. Collier	E. G. Ham
T. P. Dresser, Jr.	J. J. Laudig

List of Technical Committees and Officers

ALTHOUGH complete information will be published in the 1948 Year Book, on the personnel and officers of A.S.T.M. technical committees, this book will not be available until later in the year and hence the list given below showing the chairmen and secretaries of the technical committees will be of interest and service. This year each of the committees has held its election of officers in accordance with the Society regulations which provide for this election in the even-numbered years. In the following list an asterisk indicates new officers.

Properties of Hydrocarbons

RECENTLY published by the National Bureau of Standards is a 500-page volume, "Selected Values of Properties of Hydrocarbons." This is a complete collection of all numerical tables issued by the American Petroleum Institute Research Project 44 as of May 31, 1947. Since May, 1947, considerable other data have been compiled and issued but many would undoubtedly find it of value to have this volume which can be procured from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at $2.75 (in buckram binding). Be sure a remittance accompanies the order—Uncle Sam's printing office insists on this.

Chemical Components of Wood

A SYMPOSIUM on the Nature of the Chemical Components of Wood, organized to present the status of cellulose and lignin chemistry, has been issued by the Technical Association of the Pulp and Paper Industry, and copies can be obtained from the TAPPI office, 122 East 42nd St., New York City, at $5.00 per copy. Problems of supply of suitable pulp wood, efficient utilization of the wood, and other such problems stress the importance of the topics covered. There are ten technical papers by leading authorities, each having discussion which adds to the understanding of the specific subjects. There are numerous literature citations for further reference. The book comprises some 236 pages, heavy paper cover, 6 by 9 in.

Society Appointments

Announcement is made of the following appointments:

W. H. MEADE, Boston Edison Co., R. H. TITLEY, Public Service Electric and Gas Co., and C. P. XENIS, Consolidated Edison Co. of New York, Inc., as A.S.T.M. representatives on the new ASA Sectional Committee J6 on Rubber Protective Equipment for Electrical Workers.

Technical Committees, Chairmen and Secretaries

COMMITTEE	CHAIRMAN	SECRETARY
A-1 on Steel	N. L. Mochel, Westinghouse Electric Corp., Philadelphia 13, Pa.	*H. C. Larson, Bethlehem Steel Co., Inc., Bethlehem, Pa.
A-2 on Wrought Iron	.....	James Aston, Pittsburgh, Pa.
A-3 on Cast Iron	*E. R. Young, Climax Molybdenum Co., Chicago 1, Ill.	C. O. Burgess, Gray Irons' Society, Inc., 1010 Public Sq., Cleveland 13, Ohio
A-5 on Corrosion of Iron and Steel	T. R. Galloway, Consolidated Edison Co. of New York, Inc., New York 3, N. Y.	H. F. Hormann, Consolidated Edison Co. of New York Inc., 4 Irving Place, New York 3, N. Y.
A-6 on Magnetic Properties	*R. L. Sanford, National Bureau of Standards, Washington 25, D. C.	*J. P. Barton, Carnegie-Illinois Steel Corp., Pittsburgh 30, Pa.
A-7 on Malleable-Iron Castings	W. A. Kennedy, Grinnell Co., Inc., Providence, R. I.	James H. Lansing, Malleable Founders' Society, Cleveland 14, Ohio
A-9 on Ferro-Alloys	*W. C. Bowden, Jr., Ledoux and Co., Inc., New York 13, N. Y.	*G. F. Comstock, The Titanium Alloy Manufacturing Co., Niagara Falls, N. Y.
A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys	Jerome Strauss, Vanadium Corp. of America, New York 17, N. Y.	H. D. Newell, The Babcock and Wilcox Tube Co., Beaver Falls, Pa.
B-1 on Wires for Electrical Conductors	J. H. Foote, The Commonwealth and Southern Corp., Jackson, Mich.	*A. A. Jones, Anaconda Wire & Cable Co., Hastings-on-Hudson, N. Y.
B-2 on Non-Ferrous Metals and Alloys	*Bruce W. Gonser, Battelle Memorial Inst., Columbus 1, Ohio	G. Howard Le Fevre, U. S. Smelting, Refining and Mining Co., New York 5, N. Y.
B-3 on Corrosion of Non-Ferrous Metals and Alloys	*K. G. Compton, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	A. W. Tracy, The American Brass Co., Waterbury 88, Conn.
B-4 on Electrical Heating, Resistance, and Related Alloys	*S. A. Standing, Tung-Sol Lamp Works, Inc., Bloomfield, N. J.	F. E. Bash, Driver-Harris Co., Harrison, N. J.
B-5 on Copper and Copper Alloys, Cast and Wrought	G. H. Harnden, General Electric Co., Schenectady 5, N. Y.	V. P. Weaver, The American Brass Co., Waterbury 88, Conn.
B-6 on Die-Cast Metals and Alloys	J. R. Townsend, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	G. L. Werley, The New Jersey Zinc Co. (of Pa.), Box 263, Palmerton, Pa.
B-7 on Light Metals and Alloys, Cast and Wrought	I. V. Williams, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	J. J. Bowman, Aluminum Company of America, Pittsburgh 19, Pa.
B-8 on Electrodeposited Metallic Coatings	C. H. Sample, The International Nickel Co., Inc., New York 5, N. Y.	R. B. Saltonstall, The Udylite Corp., Detroit 11, Mich.
B-9 on Metal Powders and Metal Powder Products	W. A. Reich, General Electric Co., Schenectady, N. Y.	*Alexander Squire, Westinghouse Electric Corp., East Pittsburgh, Pa.
C-1 on Cement	F. H. Jackson, Public Roads Administration, Federal Works Agency, Washington 25, D. C.	G. E. Warren, Southwestern Portland Cement Co., Osborn, Ohio
C-2 on Magnesium Oxychloride Cements	L. S. Wells, National Bureau of Standards, Washington 25, D. C.	G. J. Fink, Oxychloride Cement Assn., Inc., Washington 6, D. C.
C-4 on Clay Pipe	J. C. Riedel, New York, N. Y.	R. G. Scott, Chicago, Ill.
C-7 on Lime	W. C. Voss, Massachusetts Institute of Technology, Cambridge, Mass.	Robert S. Boynton, National Lime Assn., Washington 5, D. C.
C-8 on Refractories	*R. B. Sosman, Rutgers University, New Brunswick, N. J.	*W. R. Kerr, Armstrong Cork Co., Beaver Falls, Pa.
C-9 on Concrete and Concrete Aggregates	Kenneth B. Woods, Purdue University, West Lafayette, Ind.	Stanton Walker, National Sand and Gravel Assn., Washington 4, D. C.
C-11 on Gypsum	L. S. Wells, National Bureau of Standards, Washington 25, D. C.	*C. E. Abbey, Gypsum Assn., Chicago 6, Ill.

Technical Committees, Chairman and Secretaries

(*Continued*)

C-12 on Mortars for Unit Masonry	Theodore I. Coe, Washington 6, D. C.	J. A. Lee, Structural Clay Products Inst., Washington 6, D. C.
C-13 on Concrete Pipe	T. F. Doll, Standard Oil Co. (Indiana), Chicago 80, Ill.	H. F. Peckworth, American Concrete Pipe Assn., Chicago 1, Ill.
C-14 on Glass and Glass Products	*H. A. Wadman, Hartford Empire Co., Hartford 2, Conn.	*F. V. Tooley, University of Illinois, Urbana, Ill.
C-15 on Manufactured Masonry Units	*J. W. Whittemore, Virginia Polytechnic Inst., Blacksburg, Va.	*J. A. Lee, Structural Clay Products Inst., Washington 6, D. C.
C-16 on Thermal Insulating Materials	Ray Thomas, Carbide and Carbon Chemicals Corp., South Charleston 3, W. Va.	*W. L. Scott, Armstrong Cork Co., Lancaster, Pa.
C-17 on Asbestos-Cement Products	*H. R. Snoke, National Bureau of Standards, Washington 25, D. C.	*C. C. Kelsey, Asbestos Cement Products Assn., New York 22, N. Y.
C-18 on Natural Building Stones	*L. W. Currier, U. S. Geological Survey, Dept. of Interior Bldg., Washington 21, D. C.	*F. S. Eaton, Research and Design Inst., Inc., New Haven 10, Conn.
C-19 on Structural Sandwich Constructions	*A. G. H. Dietz, Massachusetts Institute of Technology, Cambridge 39, Mass. (Temp.)	*E. C. Hartmann, Aluminum Research Laboratories, Aluminum Company of America, New Kensington, Pa. (Temp.)
C-20 on Acoustical Materials.	(in course of organization)	
C-21 on Whitewares	J. H. Koenig, Rutgers University, New Brunswick, N. J. (temp.)	R. F. Geller, National Bureau of Standards, Washington 25, D. C. (temp.)
D-1 on Paint, Varnish, Lacquer, and Related Products	W. T. Pearce, Bala Cynwyd, Pa.	C. H. Rose, National Lead Co., Brooklyn 1, N. Y.
D-2 on Petroleum Products and Lubricants	C. Dantsizen, General Electric Co., Schenectady 5, N. Y.	W. T. Gunn, American Petroleum Inst., New York 20, N. Y.
D-3 on Gaseous Fuels	W. A. Gauger, The Pennsylvania State College, State College, Pa.	*K. R. Knapp, American Gas Assn., Testing Laboratories, Cleveland 14, Ohio
D-4 on Road and Paving Materials	*F. H. Baumann, New Jersey State Highway Dept., Trenton, N. J.	B. A. Anderton, The Barrett Div., Allied Chemical and Dye Corp., Edgewater, N. J.
D-5 on Coal and Coke	*W. A. Selvig, Pittsburgh, Pa.	*C. H. Sawyer, Eastern Gas and Fuel Associates, Pittsburgh 12, Pa.
D-6 on Paper and Paper Products	*W. R. Willets, Titanium Pigment Corp., New York N. Y.	H. A. Birdsall, Bell Telephone Laboratories, New York 14, N. Y.
D-7 on Wood	L. J. Markwardt, U. S. Forest Products Laboratory, Madison 5, Wis.	.....
D-8 on Bituminous Waterproofing and Roofing Materials	J. S. Miller, Rahway, N. J.	H. C. Howell, Barber Asphalt Corp., Barber, N. J.
D-9 on Electrical Insulating Materials	*C. T. Hatcher, Consolidated Edison Co. of N. Y., Inc., New York 3, N. Y.	*O. E. Anderson, Westinghouse Electric Corp., Trafford, Pa.
D-10 on Shipping Containers	T. A. Carlson, U. S. Forest Products Laboratory, Madison, Wis.	E. R. Stivers, Package Research Laboratory, Rockaway, N. J.
D-11 on Rubber and Rubber-Like Materials	Simon Collier, Johns-Manville Corp., 22 E. 40th St., New York 16, N. Y.	Arthur W. Carpenter, The B. F. Goodrich Co., Akron 11, Ohio
D-12 on Soaps and Other Detergents	*F. W. Smither, Washington 15, D. C.	J. C. Harris, Monsanto Chemical Co., Dayton 7, Ohio
D-13 on Textile Materials	H. J. Ball, Lowell Textile Inst., Lowell, Mass.	W. H. Whitcomb, Cranston, R. I.
D-14 on Adhesives	*Frank W. Reinhart, National Bureau of Standards, Washington 25, D. C.	*G. W. Koehn, Armstrong Cork Co., Lancaster, Pa.

(*Continued on page 42*)

The Task Ahead

In the April issue of *Mechanical Engineering*, George A. Stetson, Editor, includes the substance of an address he made to the graduating class at Stevens Institute of Technology in January, at which time he received the honorary degree of Doctor of Engineering. A few excerpts from his address are noted here.

"The immediate task of the engineer is to maintain a high rate of production of goods and services and to extend it throughout the world wherever possible in spite of all obstacles....

"The engineer today faces the opportunity and finds himself under the responsibility of bringing into the productive process that nontechnical element of moral purpose and direction which will provide flesh and spirit to the dry bones of industrial organization. In equipping himself to do a better job in the technical phases of his work he must also equip himself for leadership in society and for service to it, unless he is content to see his technical efforts end in the frustration of war and disorganized, futile, and degenerating social systems. To save what he himself has created, he must give immediate and powerful aid to the design and operation of social, economic, and political mechanisms. Without these mechanisms, the engineer's work will be lost.... No halfway measures will do for the man who is to be fully professional in character. He must develop the whole man. He cannot neglect the sciences and their application, but neither can he neglect those other studies which give him an understanding of his fellow men and the world in which he and they live.

"He chooses to travel what Wickenden has called the Second Mile—'the mile of voluntary striving which leads to deeper experiences and higher rewards.... Where men seek excellence rather than quantity, labor for self-expression rather than material gain, and give that unrequited margin of service to the common good which alone invests work with wide and enduring significance.'"

Future Research

Whereas geographical frontiers tend to shrink as exploration proceeds, the frontiers of science are ever expanding into the unknown, and the work of science is never done. The scientists of American can be counted upon to make still greater future contributions to progress, particularly if they can have freedom in which to work, and if industry can continue to have the incentives for carrying out research that are provided by the American system of free enterprise.—From a pamphlet on Research, issued by the Standard Oil Company (Indiana) in connection with its new Whiting Research Laboratory.

Technical Committees, Chairmen, and Secretaries

(*Continued*)

D-15 on Engine Antifreezes	H. R. Wolf, General Motors Corp., Detroit 2, Mich.	E. H. Keller, E. I. du Pont de Nemours and Co., Inc., Wilmington 98, Del.
D-16 on Industrial Aromatic Hydrocarbons	D. F. Gould, The Borden Co., Philadelphia 24, Pa.	W. L. Douthett, The Texas Co., New York 17, N. Y.
D-17 on Naval Stores	V. E. Grotlisch, Production and Marketing Administration, Dept. of Agriculture, Washington 25, D. C.	W. A. Kirklan, Hercules Powder Co., Wilmington 98, Del.
D-18 on Soils for Engineering Purposes	E. J. Kilcawley, Rensselaer Polytechnic Inst., Troy, N. Y.	R. F. Blanks, U. S. Bureau of Reclamation, Denver 2, Colo.
D-19 on Water for Industrial Uses	Max Hecht, Pittsburgh 17, Pa.	R. E. Hall, Pittsburgh 30, Pa.
D-20 on Plastics	*G. M. Kline, National Bureau of Standards, Washington 25, D. C.	*B. L. Lewis, Tinius Olsen Testing Machine Co., Willow Grove, Pa.
E-1 on Methods of Testing	J. R. Townsend, Bell Telephone Laboratories, Inc., Murray Hill, N. J.	P. J. Smith, American Society for Testing Materials, Philadelphia
E-2 on Spectrographic Analysis	B. F. Scribner, National Bureau of Standards, Washington 25, D. C.	Mary E. Warga, University of Pittsburgh, Pittsburgh 13, Pa.
E-3 on Chemical Analysis of Metals	*D. R. Evans, Western Electric Co., Inc., Kearny, N. J.	J. W. Stillman, E. I. du Pont de Nemours and Co. Inc., Wilmington 98, Del.
E-4 on Metallography	L. L. Wyman, General Electric Co., Schenectady 5, N. Y.	Mary Norton, Watertown Arsenal, Watertown 72, Mass.
E-5 on Fire Tests of Materials and Construction	*A. L. Brown, Associated Factory Mutual Fire Insurance Cos., Boston 10, Mass.	Hugh M. Robinson, Underwriters' Laboratories, Inc., Chicago 11, Ill.
E-6 on Methds of Testing Building Constructions	*J. A. Liska, U. S. Forest Products Laboratory, Madison 5, Wis.	J. H. Courtney, American, Standards Assn., Washington 25, D. C.
E-7 on Radiographic Testing	*J. H. Bly, Pratt & Whitney Aircraft Division, United Aircraft Corp., East Hartford, Conn.	*D. T. O'Connor, Naval Ordnance Lab., Naval Gun Factory, Washington, D. C.
E-8 on Nomenclature and Definitions	P. V. Faragher, Pittsburgh 19, Pa.	P. J. Smith, American Society for Testing Materials, Philadelphia (*ex-officio*)
E-9 on Fatigue	R. E. Peterson, Westinghouse Electric Corp., East Pittsburgh, Pa.	O. J. Horger, The Timken Roller Bearing Co., Canton 6, Ohio
E-11 on Quality Control of Materials	H. F. Dodge, Bell Telephone Laboratories, Inc., New York 14, N. Y.	O. P. Beckwith, Alexander Smith and Sons Carpet Co., Yonkers 1, N. Y.
E-12 on Appearance	M. Rea Paul, Frederic H. Rahr, Inc., New York 22, N.Y. (temp.)	

American Wool Handbook

ALL who are familiar with the "American Wool Handbook," by Werner von Bergen and Herbert R. Mauersberger will welcome this new second edition, and others interested in wool will be glad to know that such a comprehensive study of the wool textile industry is now available. Both Professors von Bergen and Mauersberger are active members of A.S.T.M. Committee D-13 on Textiles. Dr. von Bergen is chairman of Section I on Wool of Subcommittee A-3, in which capacity he has made many very valuable contributions to the work of the committee in the standardization of specifications and methods of test for wool and wool products.

In the Author's Preface of the first edition of this Handbook, the authors expressed the hope that this book would find its place as a practical reference and textbook for the entire wool industry. This hope was more than fulfilled as was proved by the fact that the first edition was exhausted within a short time. The chief aim in the preparation of this new edition has been to bring the material up to date by careful revision and expansion of certain portions of the text. This was especially important because of extensive changes in processes and equipment which have been made since 1938, when the first edition was published.

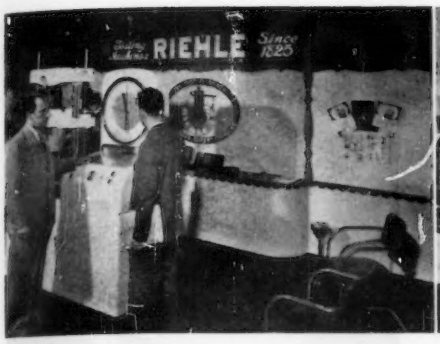
Some interesting new features in this edition are as follows: continuous solvent degreasing and continuous wool grease recovery processes are described for the first time; twist tables for woolen and worsted yarns which have never before been published and descriptions of atmospheric conditions suitable for wool processing have been added to the spinning sections; latest information on combs and spinning frames, with particular emphasis on high drafts and variable speed spinning, as well as a detailed expansion of the new American system of spinning has been added to the chapters on worsted yarn manufacturing; a new section on matching of colors and the use of instruments has been added; the description of continuous indigo dyeing in both raw stock and pieces, and of the latest methods of mothproofing are also new material; the labeling act and new tariff schedules are included. The book contains over 400 pertinent illustrations, photographs, diagrams, flow sheets, and tables.

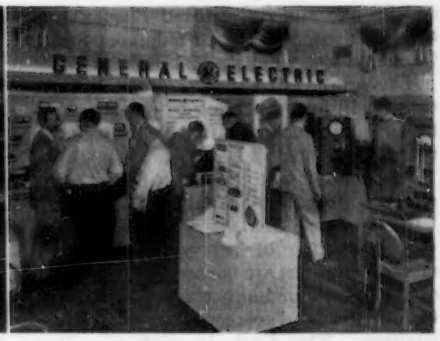
The following list of chapter headings gives some idea of the wide scope of the book: Historical and Economic Background; Sheep Breeds—Sheep Raising; Physical Properties of Wool; Chemical Nature and Properties of Wool; Specialty Hair Fibers; Reclaimed Wools and Secondary Raw Materials; Grading and Production of Wool; The Marketing of Wool; Sorting, Scouring and Carbonizing; Blending and Woolen Carding; Spinning Woolen Yarns; Worsted Carding, Combing, Topmaking; English and French Worsted Drawing; Worsted Yarn Spinning; Processes Preparatory to Weaving; Weaving of Woolens and Worsteds; Woolen and Worsted Weaves; Dyeing, Bleaching and Printing; Wet Finishing Operations; Dry Finishing Operations; Manufacture of Carpets and Rugs; The Manufacture of Felts; Physical and Chemical Testing; and Bibliography.

The book, with 1056 pages, bound in green cloth, page size 5½ by 8½ in., is published by Textile Book Publishers, Inc., 303 Fifth Ave., New York 16, N. Y. The price is $8 in the United States and Canada; $9 elsewhere.

What I am concerned about in this fast moving world in a time of crisis, both in foreign and domestic affairs, is not so much a program as a spirit of approach, not so much a mind as a heart. A program lives today and dies tomorrow. A mind, if it be open may change with each new day, but the spirit and the heart are as unchanging as the tides.

OWEN D. YOUNG





Publications on Chemical Metal Analysis Recently Added to A.S.T.M. Library

A NUMBER of the books exhibited at the March, 1948, "Symposium on Organic Reagents for Metal Analysis" have been donated to the A.S.T.M. library through the courtesy of their suppliers. Some of these books are not new but are being added to the library as valuable references, several of them being referred to in A.S.T.M. standards for additional information, and two of them having as authors well-known members of A.S.T.M. Brief reviews of these books follow:

T. R. P. Gibb, "Optical Methods of Chemical Analysis," McGraw-Hill Book Co., Inc.

This book is intended to present a concise survey of optical methods of chemical analysis, for both the practical analyst and the advanced student of analytical chemistry. A detailed coverage of the field is provided in this 391-page book which contains 300 illustrations and numerous literature references.

M. Goldberg, "English-Spanish Chemical and Medical Dictionary," McGraw-Hill Book Co., Inc.

This book is intended to fill a need for such an English-Spanish dictionary. In addition to the Spanish equivalent of the English word, a brief definition of the word is given in Spanish. This 687-page book should contain the most important terms used in chemistry, medicine, and the allied sciences.

R. C. Griffin, "Technical Methods of Analysis," McGraw-Hill Book Co., Inc.

A thorough coverage is presented of analytical methods that have been adopted as standard in a large commercial laboratory engaged is technical analysis. A chapter on reagents is included in addition to the chapters covering a wide range of organic and inorganic analyses. The organic analyses include 151 pages on analysis of foods. Tables of data and an extensive bibliography complete this 936-page book.

P. H. Groggins, "Unit Processes in Organic Synthesis," McGraw-Hill Book Co., Inc.

Those persons interested in the subject covered by this book should find it an authoritative source of a wealth of valuable information. This publication includes the contributions of thirteen authorities on specific processes in organic syntheses, compiled and edited by Mr. Groggins.

W. F. Hillebrand and G. E. F. Lundell, "Applied Inorganic Analysis," John Wiley & Sons, Inc.

Many A.S.T.M. members are no doubt familiar with this book, the value of which as a reference has been well established since it was first published in 1929. In 929 pages this book presents a thorough coverage of its subject.

Hopkin and Williams, "Organic Reagents for Organic Analysis," Chemical Publishing Co.

This detailed coverage of organic reagents for organic analysis was prepared by the staff of Hopkin and Williams, Ltd. The first part of the book discusses chemical groups and their derivatives, and the reagents recommended for identification of each. The second part of the book presents detailed discussions of the organic reagents. Also included are 55 pages of melting-point tables and a tabulation of selected organic reagents.

G. E. F. Lundell, J. I. Hoffman, and H. A. Bright, "Chemical Analysis of Iron and Steel," John Wiley & Sons, Inc.

This is another valuable reference book with which many A.S.T.M. members are already familiar. Not only are the details of procedures for analysis of iron and steel given, but each procedure's applications and usefulness are clearly discussed. Apparatus, reagents, and certain techniques used in the procedures are covered in detail in separate chapters to permit most concise descriptions of the procedures.

M. G. Mellon, "Colorimetry for Chemists," G. Frederick Smith Chemical Co.

An excellent coverage of apparatus, techniques, and other significant factors in colorimetric methods of chemical analysis is provided in this authoritative publication, which is another publication used as a reference in A.S.T.M. standards.

A. S. Morton, "Laboratory Technique in Organic Chemistry," McGraw-Hill Book Co., Inc.

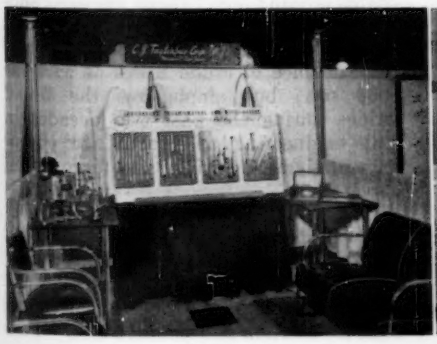
Intended for both students and research workers, this book discusses in detail the more important laboratory techniques in organic chemistry.

J. H. Perry, "Chemical Engineer's Handbook," McGraw-Hill Book Co., Inc.

This 3000-page handbook, published in 1941, covers a wealth of data and information extending over the whole field of chemical engineering and so complete as to prohibit a full description of its contents here. A great amount of useful information on almost any phase of chemical engineering should be found in this book.

G. F. Smith and F. P. Richter, "Phe-

Top and Bottom of Page—Views of Booths in 1948 A.S.T.M. Apparatus Exhibit in Detroit



nanthroline and Substituted Phenanthroline Indicators," G. Frederick Smith Chemical Co.

Those interested in this group of indicators will find this book to be a very detailed and authoritative description of them.

F. D. Snell and F. M. Biffen, "Commercial Methods of Analysis," McGraw-Hill Book Co., Inc.

A multitude of procedures for commercial analyses are covered in this publication which includes chapters on tools, techniques, and reagents used in these analyses. The book is profusely illustrated and includes references to a considerable number of A.S.T.M. methods.

F. P. Treadwell and W. T. Hall, "Analytical Chemistry," John Wiley & Sons Inc.

This publication, in two volumes, is another that is so complete and so well known as to make a detailed review here both difficult and unnecessary. Information on practically any phase of analytical chemistry can be found here, and this publication will be an especially valuable addition to the A.S.T.M. reference library.

E. Werthheim, "Textbook of Organic Chemistry," The Blakiston Company.

While intended to be a textbook for students in organic chemistry, this up-to-date publication is another valuable reference book for those occasions when one wishes to "brush up" on this subject. This 867-page book is freely illustrated and is clearly printed on good paper.

T. I. Williams, "An Introduction to Chromatography," Chemical Publishing Co.

Published in 1947, this book covers the principles and applications of chromatography as a newer method in chemical analysis.

Portland Cement Technology

PERSONS connected with any phase of the cement and concrete industry will be interested in this manual by J. C. Witt, Technical Director, Marquette Cement Manufacturing Co., that traces the development of cement technology from its early rudimentary stages to its present high scientific status.

Drawing from his many years of experience in the industry, Dr. Witt has written a book in which theoretical considerations have been minimized. Materials rather than plant equipment have been emphasized in chapters devoted to prospecting for raw materials, plant operation, engineering, research, development, consultation, and administration. Each of these chapters has been reviewed by an expert in that particular branch of cement manufacture.

This material is augmented by many complete A.S.T.M. specifications for physical and chemical tests of cement; numerous tables, charts, illustrations, and a bibliography are included.

The book was issued in 1947 by the Chemical Publishing Co., 26 Court St., Dept. 10, Brooklyn 2, N. Y., and is priced at $10.

Member from Poona, India, Visits Society Headquarters

ON MAY 14, A.S.T.M. Headquarters was visited by one of the most distant members of the Society, Rao Soheb B. V. Gharpure. Mr. Gharpure, Curator of the Lord Reay Maharashtra Industrial Museum in Poona, India, has been deputized by the Government of India to tour representative industrial establishments, laboratories, libraries, and museums in the United States and Europe. He is interested in obtaining literature, illustrative material, and exhibit material, such as photographs, slides, films, and products or materials suitable for inclusion in the museum exhibits or its library. Mr. Gharpure would be pleased to learn of any such material A.S.T.M. members may be able to make available to the museum. Correspondence may be addressed to him in care of Messrs. Thomas Cook and Son, 587 Fifth Ave., New York, 17, N. Y.

To give members some idea of the area served by this museum, a few notes follow about the city of Poona. It is significant that apparently this is not an industrial area in which the museum is located.

Poona has a population of about 500,000. It is the seat of the Government of India during the rainy season. In the city are three universities, thirteen colleges, and about fifty high schools. Mr Gharpure says that Poona has one of the best engineering colleges in India, and an agricultural college that compares favorably with the best in the world. Although Poona is not an industrial city, the fact that it is such a center of culture and education accounts for its being the site of the Lord Reay Maharashtra Industrial Museum, which was founded in 1888. The museum received its present charter in 1947 and is now being completely reorganized and expanded.

B. V. Gharpure

Laboratory Manual Refers to A.S.T.M.

AN INTERESTING new Manual for students studying the mechanical testing of materials has been prepared by Prof. W. L. Collins and J. O. Draffin of the University of Illinois. Many references to A.S.T.M. work are included. Based on earlier editions developed by the Department of Theoretical and Applied Mechanics, the new 1948 Manual has been extensively revised and is now being used in the University's resistance of materials laboratories. The following general discussion groups are covered: Failure of Materials under Static Loads; Mechanical Properties from Stress-Strain Curves; Plastic Action; and Effect of Type of Load and Test Conditions.

The authors point out that while the experiments covered give a first-hand knowledge of some of the methods used in the experimental determination of the properties of materials, the techniques of testing and verification of theory are not major objects. Therefore, the standard A.S.T.M. test procedures are not always followed or emphasized.

A large number of engineering schools use laboratory manuals, making use of the Book of Standards or the special compilation of Selected A.S.T.M. Standards for Students in Engineering. All of these manuals give the student some idea of the importance of proper determinations of properties of materials and the significance of tests.

Industrial Weighing

THIS profusely illustrated volume, by Douglas M. Considine, published by Reinhold Publishing Corp. (New York), 553 pages, $10, including over 300 drawings and photographs depicting principles and methods, as well as innumerable types of scales and their applications, covers an interesting and rather complex subject from the standpoint of a chemical and process engineer. According to the author, it was written with the view of filling part of the wide gap in literature devoted solely to the broad treatment of scales and weighing; and is intended for all persons interested in the topic—students, engineers, designers—but especially for *users* of scales. The author claims nothing novel about the basic subject, noting the establishment of the need for weighing early in man's civilization and the existence of crude scales as early as 5000 B.C., but emphasizes the broad strides during the past two decades in scale engineering, as regards new equipment designs and wider and more useful applications.

Part I of the book covering "Scale Design, Construction, and Operation," should prove most useful to those readers desiring a review of basic scale mechanics, design and construction of modern scales, and scale installation and maintenance. Part

II, "Scales in the Industries," is recommended for those interested in the application of scales in the following fields: Mining, Machinery, and Metal Products; Chemical Industries; Public Works, Service, and Transportation Industries; Food Industries; Textile and Paper Industries; Rubber and Plastics Industries. This portion of the book, with its many and varied pictured applications, is most informative, giving sufficient background of processing details and complexities peculiar to the various industries to provide the reader with an over-all conception of the indispensability and importance of weight control.

Pages 485 to 539 are devoted to a Glossary of Scale Terms, as compiled by the National Scale Men's Association, and reflecting the views and approaches of experienced scale engineers and weighmen. An Appendix covers a Table of Densities of some 200 Typical Solid Materials, and a Table of Systems of Weights in certain foreign countries, with U. S. Equivalents.

Engineering Societies Yearbook

The Engineering Societies Yearbook, 1948. Harry B. Coffin, Editor. The American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. Paper, 8½ by 11 in., 95 pp., $3.

THE initial edition of a planned series of reference books sponsored by The Engineers Joint Council and designed to give detailed information on engineering societies, clubs, and councils in the United States and Canada, this concise and comprehensive collection of data is a valuable contribution to the engineering world, filling a long-felt want. The data supplied by 318 organizations (83 national, 174 state, regional and local; 35 Canadian, 8 international, 13 engineering employee, and 5 engineering joint bodies) include name and office address of society, with corresponding abbreviation, name of state and city, affiliated organizations and societies, facilities and type of organization, times and places of meetings, grades, and other features of membership interest, committees, publications, and other information. There are also statements covering aims, purposes, and activities, and such special interests as student scholarships, loans, and awards.

In addition to the complete engineering society lists, there is a list of registration boards for licensing of professional engineers, with addresses and general information, also a list of the 134 accredited engineering curricula of engineering colleges and institutions as approved by The Engineers' Council for Professional Development. An interesting graph shows the phenomenal growth of membership of the societies composing the ECPD, with convincing evidence of the vital role engineering and affiliated interests have played in making the United States the leading nation of the world.

There is a full-page map locating the engineering societies distributed over the United States and Canada, also a double-page map showing locations of local sections or chapters of the societies which compose the ECPD (seven in the United States and one in Canada). A bibliography covers publications on engineering organization and a list of ECPD publications. A complete index concludes this handy and important reference book, and "Canons of Ethics for Engineers" and "Faith of the Engineer" are reprinted on the back cover page.

A.S.T.M. Publications Displayed Abroad

THROUGH the interest of Prof. F. Campus, of the University of Liége, Belgium, quite a number of the Society's publications were on display in the International Exhibition of Scientific Research and Industrial Control, held in the fall of 1947 at the university.

Adjoining the A.S.T.M. display were others in the same general field including the work of the Swiss Federal Laboratory for Testing Materials, the Laboratoire central du Batiment et des Travaux Publics of Paris, some special testing machines from Professor Campus' laboratory, etc. Professor Campus has been a member of the Society for many years.

British Scientific Instrument Manufacturers' Association Handbook

THE S.I.M.A. Handbook issued by the Scientific Instrument Manufacturers' Association of Great Britain, Ltd., was finished early this year. One of the main features of this 220-page book is an alphabetical index (containing about 2000 entries) of the products made by the members-firms of the Association, supplemented by a list of the firms with their products. By using these lists, it is easy to discover in a few moments the names and addresses of the makers of almost any type of scientific instrument, as well as the products of any particular firm.

The handbook, which is nearly double the size of the previous edition, contains also full information about the Association, an illustrated review of the British Scientific Instrument Industry and its work, an 8-page list of research organizations, and much other matter.

Copies of the book may be obtained from the Association at 26 Russell Square, London, W.C.1, at 10/6*d*. post free.

Article on Adhesives

A very enlightening article appeared in the July issue of *Electrical Manufacturing* entitled, "Adhesives, Too, Are Fasteners." The authors present an interesting analysis of the factors involved in the selection and use of adhesives especially from the viewpoint of a design engineer. Tables are included giving a check list for the design engineer in selecting a proper adhesive and a condensed classification of adhesives. Recognition is given to the work of A.S.T.M. Committee D-14 on Adhesives and especially to the list of definitions of adhesive terms now published under A.S.T.M. designation D 907–47 T.

Information for Refractories Directory

THE Directory of the Refractories Industry is to be issued in amplified and revised form, and the American Refractories Institute which sponsors it wishes to give as complete coverage as possible to the refractories companies in the United States. Any such organizations which have not submitted information to the Institute are requested to do so. The Directory lists names, addresses, plant locations, and an alphabetical listing of refractory products by brand names. Information can be sent to the President of the Institute, W. J. Westphalen, Railway Exchange Building, St. Louis, Mo.

New Viscosity Oil Standards

THE A.P.I. Subcommittee on Viscosity Standards has completed the restandardization of its oil standards Alpha 48, Beta 48, and Gamma 48. These oils are used for the calibration of viscosimeters of both the kinematic and Saybolt types. This year, for the first time, the committee is offering an oil for calibration at −40 F. The viscosity values for the 1948 oils are shown below:

These A.P.I. oil standards are available in 8-oz. and 1-qt. samples at $2.50 and $5.00 per sample, respectively. Purchase orders should be accompanied by remittance payable to the American Petroleum Institute and should be addressed to Lacey Walker, Secretary, American Petroleum Institute, 50 West 50th St., New York 20, N. Y. Shipment will be made by express collect, to points within the United States unless otherwise specified by the purchaser. Method of shipment must be specified and charges paid by purchaser ordering oil for shipment outside the United States.

	Alpha 48		Beta 48			Gamma 48	
Temperature, deg. F..	100	210	100	122	210	100	−40
Centistokes.....	65.77	7.81	417.3	...	24.22	2.977	74.5
Saybolt Univ.....	304.0	51.7	1928	...	116.3	35.9	341
Saybolt Furol.....	....	....	....	92.2	....	.....	....

Standardization Activities

(Continued from page 29)

Two methods to be applied for the determination of steam purity—Dissolved Solids in Water of High Purity and the Electrical Conductance Method—are expected to be available during the year. In addition both methods may be used for the examination of other types of industrial water. Additional methods involving the use of special methods are being developed. These methods are applicable to the examination of water-formed deposits and include the use of the petrographic microscope, the spectroscope and the spectrograph. Additional methods involving the inspection of biological desposits and microorganisms in water are in development. Further study is being made on the classification of industrial waters. Specifications are in preparation for synthetic sea water for use in the laboratory testing of corrosivity and for the corrosivity of industrial waters, to be determined by subjecting specimens of tubular products in by-pass lines.

Those of the Society members who are interested in the subject of steam generation will find of interest the following: "Proposed Revisions and Addenda to Suggested Rules for the Care of Power Boilers, Section 7 of A.S.M.E. Boiler Construction Code." Publication of this material was made in *Mechanical Engineering*, June, 1948. The Boiler Code Committee welcomes discussion on this presentation from any interested operator. These rules cover the cleaning out and laying up of boilers; scale, sludge, and oil; corrosion; cracking and embrittlement of boiler steel; carryover, priming, and foaming,; and also sampling, testing, and reporting of analysis of water and steam samples.

Fire Tests (E-5)

A need for a standard test method or methods on which criteria for permanence for the different classifications of acoustical and similar finishes can be based is being considered by Committee E-5. An effort is being made to define and standardize the tests required for determining the pertinent properties of roofing materials so that they will indicate more or less continuous scales of permanence. The feasibility of developing a fire test of steel beams and girders in unloaded conditions will be investigated, the permanence to be judged by transmission of heat through the protection rather than by permanence under load. A proposed method of test for incombustibility of solid materials has been drafted for publication as information only and thus establish its reliability as a test procedure before being recommended as an A.S.T.M. standard.

Building Construction (E-6)

Standardization work by Committee E-6 will include a review of the new tentative methods of conducting strength tests of panels for building construction (E 72 T). Three projects are under way involving methods of testing joints between prefabricated panels to determine the strength of the connections laterally and in shear. Preparation of methods of testing truss assemblies is expected to be completed during the coming year and a proposed tentative will be submitted to the Society. A preliminary draft of a proposed tentative method of testing prefabricated floor and roof constructions is being circulated for comment. Development of a method of testing resistance to rain penetration by panels representing exterior wall and roof construction is being undertaken as well as methods for rating the durability of composite elements of buildings under limited conditions of exposure. A further review is being given to a draft of a proposed test for the laboratory measurement of air-born sound transmission loss of building floors and walls.

Committee E-9 on Fatigue (E-9)

The work of Committee E-9 on Fatigue during the current year will be devoted primarily to completing as soon as possible the Manual on Fatigue Testing. The chapter on Nomenclature is being published elsewhere in this Bulletin for general review by members of the Society and the committee would appreciate any comments thereon. Later in the year it is expected that an article on the Application of Statistical Methods to Fatigue Data will be published for general review and comment, looking eventually to including this as an appendix to the Manual. A cooperative setup has been made with the British Mechanics Engineering Research Board represented by Dr. Herbert J. Gough.

Calendar of Society Meetings

Department of State—First Inter-American Conference on Conservation of Renewable Natural Resources, September 7–20, Denver, Colo.

American Society of Mechanical Engineers—Instruments and Regulators Division Meeting, September 13–17, Philadelphia, Pa.

American Chemical Society—Western Session, 114th National Meeting, September 13–17, Portland, Ore.

American Association for the Advancement of Science—Centennial Meeting, September 13–17, Washington, D. C.

Instrument Society of America—Annual Meeting, Third Annual Instrument Conference and Exhibit, September 13–17, Convention Hall, Philadelphia, Pa.

Pacific Coast Gas Association—Annual Convention, September 14–16, Hotel Casa del Rey, Santa Cruz, Calif.

National Petroleum Association—September 15–17, Hotel Traymore, Atlantic City, N. J.

Illuminating Engineering Society—Annual Convention, September 15–19, New Orleans, La.

American Petroleum Institute—Lubrication Committee, September 16–18, Hotel Traymore, Atlantic City, N. J.

American Society of Mechanical Engineers—Aviation Division Meeting, September 20–21, Dayton, Ohio

Illuminating Engineering Society—National Technical Conference, September 20–24, Boston, Mass.

American Mining Congress—Metal Mining Convention and Exposition, September 20–25, San Francisco, Calif.

Society of the Plastics Industry—National Plastics Exposition, September 27–October 2, Grand Central Palace, New York, N. Y.

Association of Iron and Steel Engineers—Annual Convention, Iron and Steel Exposition, September 28–October 1, Public Auditorium, Cleveland, Ohio.

Institute of Radio Engineers—Pacific Coast Convention, September 30–October 2, Los Angeles, Calif.

American Gas Association—Annual Meeting, October 4–9, Atlantic City, N. J.

American Institute of Electrical Engineers—Middle Eastern District Meeting, October 5–7, Hotel Statler, Washington, D. C.

Industrial Packaging Engineers Association of America—October 5–7, Sherman Hotel, Chicago, Ill.

Concrete Reinforcing Steel Institute—Semiannual Meeting, October 5–9, Asheville, N. C.

National Lubricating Grease Institute—Annual Meeting, October 11–13, Edgewater Beach Hotel, Chicago, Ill.

American Chemical Society—Chicago Section, National Chemical Exposition, October 12–16, Coliseum, Chicago, Ill.

American Society of Civil Engineers—Fall Meeting, October 13–15, Statler Hotel, Boston, Mass.

Porcelain Enamel Institute—Tenth Annual Forum, October 13–15, Urbana, Ill.

American Oil Chemists Society—October 15–17, New York, N. Y.

Engineers' Society of Western Pennsylvania—Ninth Annual Water Conference, October 18–20, Hotel William Penn Pittsburgh, Pa.

National Institute of Governmental Purchasing—Third Annual Conference and Products Exhibit—"Governmental Buying Advance"—October 18–20, Bellevue-Stratford Hotel, Philadelphia, Pa.

American Institute of Electrical Engineers—Midwest General Meeting, October 18–22, Schroeder Hotel, Milwaukee, Wis.

American Association of Textile Chemists and Colorists—Annual Convention, October 21–23, Sheraton-Bon Air Hotel, Augusta, Ga.

Association of Consulting Chemists and Chemical Engineers—Annual Meeting, October 26, Hotel Sheraton, New York, N. Y.

American Society for Metals—National Metals Congress and Exposition, October 25–29, Commercial Museum and Convention Hall, Philadelphia, Pa.

Society of Automotive Engineers—Fuels and Lubricants Div., November 4–5, Mayo Hotel, Tulsa, Okla.

Federation of Paint and Varnish Production Clubs and Paint Industries Show—26th Annual Meeting, November 4–6, Congress Hotel, Chicago, Ill.

American Institute of Chemical Engineers—Annual Meeting, November 7–10, Hotel Pennsylvania, New York, N. Y.

National Paint, Varnish and Lacquer Association—60th Annual Convention November 8–10, Congress Hotel, Chicago, Ill.

New Members to July 12, 1948

The following 112 members were elected from April 26, 1948, to July 12, 1948, making the total membership 6484.

Names are arranged alphabetically—company members first, then individuals.

Chicago District

FLOOR AND ASSOCIATES, INC., Erik Floor, President, 139 N. Clark St., Chicago 2, Ill.
KESTER SOLDER CO., F. C. Engelhart, President, 4201 Wrightwood Ave., Chicago 39, Ill.
SERVICISED PRODUCTS CORP., Mrs. Helene Patterson, Chemist, 6051 W. Sixty-fifth St., Chicago 38, Ill.
ALGEO, HAROLD L., Engineer, Perkins & Will, Architects, Room 2200, 309 W. Jackson Blvd., Chicago 6, Ill.
HANSON, ARTHUR C., Research Chemist, Rock Island Arsenal, Rock Island, Ill.
HUNT, EDWARD A., Chief Metallurgist, The Massey-Harris Co., Racine, Wis.
KAVANAUGH, WILLIAM R., Material Test Engineer, City of Chicago, Bureau of Sewers, Chicago, Ill. For mail: 3211 N. Keating Ave., Chicago 41, Ill.
LOCKE, CHARLES, Supervisor, Foundry Process Research, Armour Research Foundation, Chicago 16, Ill.
WILDERMUTH, ARTHUR L., Metallurgist, Advance Aluminum Casting Corp., 2742 W. Thirty-sixth Pl., Chicago 32, Ill.
WITTHOFT, HERBERT C., Technical Supervisor, Anaconda Wire and Cable Co., Marion, Ind.

Cleveland District

EBERLE, FRITZ, Chief Metallurgist, The Babcock & Wilcox Co., Research and Development, Harrisburg and Sawburg Rds., Alliance, Ohio.
EVERLING, W. O., Director of Research, American Steel and Wire Co., Rockefeller Bldg., Cleveland 13, Ohio.
KNAPP, K. R., Assistant Director, Testing Labs., American Gas Assn., 1032 E. Sixty-second St., Cleveland 14, Ohio.
LUCAS, JOSEPH M., Manager, Ceramic Division, The U. S. Stoneware Co., Box 350 Akron 9, Ohio.
ROEHL, EDWARD J., Manager of Technical Development, Thomas Steel Co., Warren, Ohio.

Detroit District

DAVIS, A. W., Manager, Construction Equipment Div., Electric Tamper and Equipment Co., Ludington, Mich.
ROBERTS, HOWARD W., Engineer, Ingham County Road Commission, Mason, Mich.

New England District

BOSTON WOOL TRADE ASSN., James H. Stannard, Chairman, Technical Committee, 263 Summer St., Boston 10, Mass.
DAVIS, L. W., Vice-President, Metal Hydrides, Inc., Beverly, Mass.
EDWARDS, THOMAS C., Technical Director, Acushnet Process Co., New Bedford, Mass.
LACHMAN, LOUIS ALBERT, Director of Engineering, New London Junior College, New London, Conn.
METROPOLITAN DISTRICT, THE, WATER BUREAU, 2 American Row, Hartford 4, Conn.

New York District

BURLINGTON MILLS CORP. OF NEW YORK, John G. Stass, 1410 Broadway, New York 18, N. Y.
NEWTON-NEW HAVEN CO., THE, W. W. Broughton, Technical Representative, Box 1101, New Haven, Conn.
UNDERWEAR INST., Roy A. Cheney, President, 2 Park Ave., New York 16, N. Y.
UNION HARDWARE CO., William H. Foley, Industrial Engineer, 535 Migeon Ave., Torrington, Conn.
CHEMISTS' CLUB LIBRARY, THE, 52 E. Forty-first St., New York 17, N. Y.
HOBART, RAYMOND HALL, Manager, The Haller Testing Laboratories, Inc., 255 Wooster St., New Haven, Conn.
LAWSON, CLEMENT C., Wire Development Engineer, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
POLLACK, MAXWELL A., Technical Consultant, Hardesty Chemical Co., Inc., 41 E. Forty-second St., New York, N. Y.
TAYLOR, JAMES, Engineer of Tests, American Locomotive Co., Schenectady, N. Y.
TAYLOR, NEIL R., Assistant Manager of Metal Sales, United States Smelting, Refining and Mining Co., Inc., 57 William St., New York 5, N. Y.
WINSHIP, WILLIAM W., Owner, Winship Silica Products Co., First National Bank Bldg., Freeport, L. I., N. Y.
ZIMMER, A. S., Chief Engineer, Hygrade Products Division, Standard Motor Products, Inc., 35-35 Thirty-fifth St., Long Island City 1, N. Y.

Northern California District

TOMLINSON, JAMES A., Quality Control Manager, Owens-Corning Fiberglas Corp., Pacific Coast Div., Box 89, Santa Clara, Calif.

Ohio Valley District

(In Course of Organization)

GONSER, BRUCE W., Supervisor, Nonferrous Research, Battelle Memorial Inst., 505 King Ave., Columbus 1, Ohio.
HEIL, VERNON E., Research Engineer and Section Head, P. R. Mallory and Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind.
HELLER, J. E., Technical Director, The Thresher Paint and Varnish Co., 1100 E. Monument Ave., Dayton 1, Ohio. Yeager Ulysses B., Fuel Engineer, Island Creek Coal Sales Co., 700 Guaranty Bank Bldg., Huntington 18, W. Va.

Philadelphia District

DU PONT DE NEMOURS AND CO., INC., E. I., EXPLOSIVES DEPT., R. S. Apple, Research Supervisor, Burnside Laboratory, Box 152, Pennsgrove, N. J.
GENERAL INDUSTRIES, INCORPORATED, Robert B. Yule, Chief Structural Engineer, 311 S. Broad St., Philadelphia 7, Pa.
DEMAURIAC, WILLIAM J., Assistant Superintendent, The Philadelphia Electric Co., Twenty-seventh and Christian St., Philadelphia 46, Pa.
KEPLER, F. M., Manager, Henry Vogt Machine Co., 1338 Commercial Trust Bldg., Philadelphia 2, Pa.
NATIONAL PRINTING INK RESEARCH INST., A. C. Zettlemoyer, Research Director, Lehigh University, Chemistry Dept., Bethlehem, Pa.
SUTTON, BRUCE L., Sales Engineer, The Baldwin Locomotive Works, Pniladelphia 42, Pa.

Pittsburgh District

PORTER CO., INC., H. K., Clarence R. Abitz, Works Manager, 1932 Oliver Bldg., Pittsburgh 22, Pa.
ALLEN, HERRICK K., Development Engineer, National Forge and Ordnance Co., Irvine, Warren County, Pa.
BRITTON, RAY E., Consulting Engineer, Pennsylvania Slag Assn., 1519 Oliver Bldg., Pittsburgh 22, Pa. For mail: 510 Clen-Moore Blvd., New Castle, Pa.
HALL, EDWARD E., Chief Metallurgist, Universal-Cyclops Steel Corp., Titusville, Pa.
HAUCK, CHARLES F., Hall Laboratories, Inc., 323 Fourth Ave., Pittsburgh, Pa. For mail: 1179 Cedar Blvd., Pittsburgh 16, Pa.
SHERWIN, EDWIN T., Engineer, Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.
STOBBS, HENRY A., Supervisor of Tests, Wheeling Steel Corp., Yorkville Works, Yorkville, Ohio.
WITSBERGER, CLARENCE J., Electrical Engineer, Pennsylvania Transformer Co., Canonsburg, Pa.

St. Louis District

CORTELYOU, F. M., JR., Partner, Harrington & Cortelyou, 1004 Baltimore Ave., Kansas City, Mo.
FIELDS, E. B., Engineer of Tests, Atchison, Topeka and Santa Fe Railway Co., 14 Motive Power Bldg., Topeka, Kans.
LUTZ, HOBART F., Consulting Engineer, 819 Finance Bldg., Kansas City 6, Mo.
MUSHKAT, LOUIS, Manager, American Lead Products Co., 2939 Chouteau Ave., St. Louis 3, Mo.
SUMNER, L. T., Chief Engineer, Fischer Lime and Cement Co., 269 Walnut St., Memphis 3, Tenn.
TAYLOR, RUSSELL C., Mechanical Engineer, Development and Tests, American Steel Foundries, Granite City, Ill.
WASHINGTON UNIVERSITY LIBRARY, St. Louis 5, Mo.

Southern California District

CHISHOLM, RODERICK A., Materials Engineer, Corps of Engineers, Office of Division Engineer, South Pacific Materials Laboratory, 751 S. Figuerod, Los Angeles, Calif. For mail: 3539 119th Pl., Inglewood, Calif.
DUIM, A. R., Division Manager, Mission Appliance Corp., 12611 S. Crenshaw Blvd., Los Angeles, Calif. For mail: Hyde Park Station, Los Angeles 43, Calif.
JEFFREYS, C. E. P., Director of Research, Truesdail Laboratories, Inc., 4101 N. Figueroa St., Los Angeles, Calif. For mail: 2240 Adair St., San Marino 9, Calif.
LUCKHAM, ALGER W., Architectural Specifications Writer, 3418 Community Ave., La Crescenta, Calif.
SAN DIEGO, CITY OF, Alden K. Fogg, City Engineer, Room 266, Civic Center, San Diego 1, Calif.
SAN DIEGO, CITY OF, PUBLIC LIBRARY, Clara E. Breed, City Librarian, Eighth Ave. and E Sts., San Diego 1, Calif.

Washington (D. C.) District

PEMCO CORP., E. G. Porst, Chief Chemist, 5601 Eastern Ave., Baltimore 24, Md.
RUBATEX DIVISION, GREAT AMERICAN INDUSTRIES, INC., L. G. Norman, Chief Chemist, Bedford, Va.
DILL, RICHARD S., Chief, Heating and Air Conditioning Section, National Bureau of Standards, Washington 25, D. C.
HOWARD, PAUL T., Chemist, National Bureau of Standards, 412 Chemistry Bldg., Washington 25, D. C.
HUGHES, ROBERT H., Chief Engineer, Clinchfield Coal Corp., Box 1, Dante, Va.
LAMB, JAMES H., Secretary, Contest Board, American Automobile Assn., Seventeenth and Pennsylvania Ave., N. W., Washington, D. C.
MERRITT, GEORGE J., Chemist, U. S. Army, Quartermaster Corps, Washington 25, D. C. For mail: 2415 N. Underwood St., Falls Church, Va.
OHLHEISER, CARLTON E., Development Engineer, American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.

Western New York and Ontario District

HARMON, CARL A., Chief Metallurgist, Great Lake Steel Corp., Hanna Furnace Div., 1000 Walbridge Bldg., Buffalo 2, N. Y.
MOSHER, FRED D., Research Engineer, Standard Stoker Co., Inc., Erie, Pa.
WALTER, JOHN, Materials Engineer, Ontario Department of Highways, Parliament Bldg., Toronto, Ont., Canada.

U. S. and Possessions

CROWN ZELLERBACH CORP., CENTRAL RESEARCH AND TECHNICAL DEPT., William R. Barber, Technical Director, Camas, Wash.
STANOLIND OIL AND GAS CO., Scott W. Walker, Process Research Supervisor, Box 591, Tulsa 2, Okla.

WARREN PETROLEUM CORP., H. W. Harts, Vice-President, Box 1589, Tulsa, Okla.

COUNTS, JACK EDWIN, Research and Sales Engineer, Pumice Aggregate Sales Corp., 121 S. Yale, Albuquerque, N. Mex. For mail: 1511 N. W. Seventeenth, Oklahoma City, Okla.

HARDY, EDGAR E., Research Supervisor, Phosphate Division, Monsanto Chemical Co., Anniston, Ala.

JOHNSTON, LEE R., Material Inspector, A. W. Williams Inspection Co., Mobile, Ala. For mail: 1063 Palmetto St., Mobile 20, Ala.

JONES, VALENS, Engineer, Research, U. S. Bureau of Reclamation, Bldg. 1B, Denver Federal Center, Denver 1, Colo.

PAGE, CHARLES H., JR., Partner, C. H. Page and Son, Architects-Engineers, Box 936, Austin, Tex.

PENNINGTON, JOHN V., Associate Director, Southwest Research Inst., 217 Oil and Gas Bldg., Houston 2, Tex.

PETTIGROVE, A. J., Chief Engineer, Stanolind Oil and Gas Co., Box 591, Tulsa, Okla. For mail: 3222 S. Utica, Tulsa, Okla.

PRICE, JOHN D., Superintendent, Coke Plant, Colorado Fuel and Iron Corp., Pueblo, Colo.

SEATTLE, CITY OF, DEPARTMENT OF LIGHTING, E. R. Hoffman, Superintendent of Lighting, 1015 Third Ave., Seattle 4, Wash.

TACOMA, CITY OF, CITY ENGINEER, 503 City Hall, Tacoma 2, Wash.

WAGER, RALPH WALDO, Associate Professor of Chemistry; and Consultant, Rollins College, Winter Park, Fla.

WITT, ROBERT P. Professor, Civil Engineering Dept., Oklahoma Agricultural and Mechanical College, Stillwater, Okla.

WITTE, LESLIE P., Materials Engineer, U. S. Bureau of Reclamation, Bldg. 1B, Denver Federal Center, Denver 2, Colo.

Other than U. S. Possessions

DOMINION TAR AND CHEMICAL CO., LTD., J. C. Langford, Development Engineer, 2240 Sun Life Bldg., Montreal, P. Q., Canada.

IMPERIAL CHEMICAL INDUSTRIES, LTD., LEATHERCLOTH DIVISION, LIBRARY, A. G. Kay, Librarian, Newton Works, Hyde, Cheshire, England.

SOCIETE NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION, Librarian Central Laboratory, 22 Quai Gallieni, Suresnes, Seine, France.

BARTORELLI, LUIGI, Plasticos Plavinil S. A., 290 Rua S. Bento, 1ª Sobre-loja, Saã Paulo, Brazil.

BELOTTI, AGOSTINO, Representative in Italy for Waukesha Motor Co., Waukesha, Wis., and Tinius Olsen Testing Machine Co., Philadelphia, Pa. For mail: Piazza Trento 8, Milan, Italy.

BLUNDELL, WILLIAM R., Dominion Rubber Co., Ltd., General Labs., 1665 Notre Dame St., East, Montreal, P. Q., Canada.

BRITISH WELDING RESEARCH ASSN., H. G. Taylor, Director of Research, 29 Park Crescent, London W. 1. England.

COHEN, HERMAN, Director, Union Research Laboratories, Ltd., Realty Trust Bldgs., Johannesburg, South Africa.

COLLEGE OF ENGINEERING, Principal, Poona 5, India.

DENARO, L. F., Engineering Metallurgist, The Mond Nickel Co., Ltd., London, England. For mail: 25 Clariden Strasse, Zurich, Switzerland.

HANSEN, GEORGE H., Chemist, The Trinidad Lake Asphalt Operating Co., Ltd., Box 180, Port of Spain, Trinidad, B. W. I.

INDIA, HEADQUARTERS, SOUTHERN COMMAND, Poona 1, India.

INDIA, HEADQUARTERS, WESTERN COMMAND, "F" Block, Hutments, New Delhi, India.

KUREM, SAIM, Chief Chemist and Luboil Manager, Petrol Ofisi, Kozluca Han, Galata, Istanbul, Turkey.

MACKNEY, A. E., President, A. E. A. Sales, Ltd., 911 Vancouver Block, Vancouver, B. C., Canada.

NATIONAL METALLURGICAL LABORATORY, G. P. Contractor, Assistant Director, Jamshedpur, Via Tatanagar, B. N. Ry., India.

PAULIN, W. T., Production Manager, The Milburn Lime and Cement Co., Ltd., Box 400, Dunedin, New Zealand.

SMITH, DONALD J., Building Products, Ltd., Box 6063, Montreal, P. Q., Canada.

ZSCHOKKE, H. R., Chief of Laboratory for Testing Materials, Brown, Boveri and Co., Ltd., Baden-Aargau, Switzerland. For mail: Sennhauserweg 18, Zurich 32, Switzerland.

Personals . . .

. . . News items concerning the activities of our members will be welcomed for inclusion in this column.

Lincoln T. Work, Director of Research and Development, Metal and Thermit Corp., Rahway, N. J., has been elected Vice-Chairman of the New York Chapter of the American Institute of Chemists.

Russell Franks has been made Chief Metallurgist, with headquarters in Pittsburgh, of the Electro Metallurgical Co.

Herman Francis Mark, of the Polytechnic Institute of Brooklyn, has been chosen by the Rochester Section of the American Chemical Society as the fourth Harrison Howe lecturer, the lecture to be presented in mid-November. Dr. Mark, an international authority on the chemistry of high polymers, has done extensive work in the specific fields of rubber, cellulose, and plastics, having served as Research Director of the Canadian International Paper Co., Professor of Chemistry at the University of Vienna, and as a Research Director for the I. G. Farbenindustrie. He presently represents the Brooklyn Polytechnic Institute on the recently organized A.S.T.M. Committee C-19 on Structural Sandwich Constructions.

Harry C. Plummer, Director of Engineering and Research, Structural Clay Products Institute, was recently inducted as an honorary member of the National Professional Ceramic Engineering Fraternity Keramos, the initiation taking place in the North Carolina State College Chapter, Raleigh. The selection recognized Mr. Plummer's outstanding contributions to the brick and tile engineering profession in his present capacity with the Structural Clay Products Institute.

Carl S. Miner, Director of the Miner Laboratories, Chicago, received the honorary degree of Doctor of Science at the commencement exercises of Coe College, Cedar Rapids, Iowa, on June 5.

Frank E. Lobaugh, formerly Technical Service Director of the Lumnite Division, Universal Atlas Cement Co., New York City, is now Vice-President of the Lumnite Division, succeeding Joshua L. Miner, recently retired.

Herbert K. Cook has been named Chief of the Concrete Research Division of the Waterways Experiment Station, Vicksburg, Miss.

James B. Morrow, First Vice-President of Pittsburgh Consolidation Coal Co., has been elected President of Bituminous Coal Research, Inc., the national research agency of the bituminous coal industry. An authority on coal preparation, Mr. Morrow has written extensively on the subject of cleaning and sampling of coal. He has been active in A.S.T.M. committee work on coal classification and testing.

R. Bowling Barnes, formerly with the American Cyanamid Co., has been elected Vice-President in Charge of Research and Development of the American Optical Co., Southbridge, Mass.

A. G. Ashcroft, Director of Research and Development, **Alexander Smith & Sons Carpet Co.,** Yonkers, N. Y., has announced the employment of Jesse de la Rama as Quality Control Engineer in the Product Engineering Laboratories.

William P. Werner, President, **Pecora Paint Co.,** Philadelphia, is in his 45th year of service with the Pecora Company. This company is among the current 40-year A.S.T.M. members appearing elsewhere in this issue, and Mr. Werner, himself, is a long-time A.S.T.M. member.

Raymond H. Schaefer has been appointed Director of Research and Development, American Brake Shoe Co., New York. He started with the Company in 1940 as an Assistant Foundry Metallurgist, American Manganese Steel Division, and in 1945 became Chief Metallurgist in Charge of Metallurgical Research and the Company's experimental foundry.

R. F. Miller, Development Engineer in stainless and alloy steels, Research and Technology Department, Carnegie-Illinois Steel Corp., Pittsburgh, has been appointed Assistant to Vice-President of that department.

James T. MacKenzie, Technical Director, American Cast Iron Pipe Co., has been elected Chairman, Birmingham Chapter, American Foundrymen's Association.

Alvah Small, President of Underwriters' Laboratories, Inc., Chicago, since 1935, was elected Vice-Chairman at a recent special meeting of the Board of Trustees, held in New York. Upon Mr. Small's assumption of the duties as Vice-Chairman, **Curtis R. Welborn,** since 1947 Executive Vice-President, was elected President of Underwriters' Laboratories, Inc.

J. L. McCloud has been appointed Director of Chemical Engineering and Chemical and Metallurgical Research, Ford Motor Co., succeeding the late R. H.

McCarroll. Mr. McCloud has been with the Ford Co. since 1915, serving in various capacities, having been Assistant Director of Chemical Engineering since 1946.

Lawrence C. Flickinger has been appointed Chief Chemist for the Youngstown district of the Youngstown Sheet & Tube Co., succeeding the late David A. Russell.

R. G. McElwee, Manager, Foundry Alloy Division, Vanadium Corp. of America, Detroit, has been chosen as Chairman of the Gray Iron Division of American Foundrymen's Association. Formerly Vice-Chairman of the division, he has also served as head of the cupola research group and vice-chairman of the program and papers committee. He succeeds, as chairman, Russell J. Allen, Metallurgical Engineer with Worthington Pump & Machinery Corp., Harrison, N. J., who resigned the chairmanship because of ill health.

Charles H. Greenall, active in A.S.T.M. work for many years and chairman of Committee B-5 from 1937 to 1944, is taking a year of absence from active work on the advice of his physician. He was formerly at the Bell Telephone Laboratories, and later Director of the Laboratory at Frankford Arsenal, Philadelphia, in World War II, and most recently Executive Director of the Franklin Institute Laboratories for Research and Development. He has resigned his position at the Institute and plans to do some traveling and spend some time in the South and Southwest. During World War I, Charlie had one of his feet frozen which apparently left the limb rather susceptible; later there were one or two additional freezings, the most recent one this winter, and complications have led to the doctor's advice for him to favor this condition.

Thomas M. Kelly, formerly Materials Engineer, National Bureau of Standards, Washington, D. C., is now serving in a similar capacity with the Corps of Engineers, U. S. Dept. of the Army, Portland, Ore.

Charles Doak Lowry, Jr., previously with the Universal Oil Products Co., Chicago, Ill., has been appointed Exec. Director, Panel on Petroleum, U. S. Research and Development Board, Washington, D. C.

Alexander E. Wallace is now associated with Purity Products Co., Mayville, Wis. He was formerly Research Engr., M & R Dietetic Labs., Inc., Columbus, Ohio.

Raul Valle-Rodas, who had been associated with Direccion de Obras de Riego, Ministerio de Obras Publicas, Caracas, Venezuela, and with the Knappen Engineering Co., New York City, has accepted an appointment with the Laboratorio de Ensayo de Materiales, Ministerio de Obras Publicas, Venezuela.

Miguel Walter Escobar, formerly Chief Chemist, Federated Metals Div., American Smelting & Refining Co., Los Angeles, is now on the staff of the Associated Smelting Corp., Oakland, Calif.

Fred J. Tobias has accepted appointment with Hampden Brass & Aluminum Co., Springfield, Mass.

C. L. Dalzell is now Asst. Chief Engr., Central Soya Co., Inc., Decatur, Ind. He was previously with the General Foods Corp., New York City.

Henry Guildford Hoskins is now Chief Metallurgist, Aluminum Co. of South Africa, Pty., Ltd., Pietermaritzburg, Natal, South Africa. He was formeriy associated with the Northern Aluminium Co., Ltd., Banbury, Oxfordshire, England, as Research Metallurgist.

H. L. MacBride has accepted appointment as Manager, Testing Machine Div., National Forge & Ordnance Co., Irvine, Warren County, Pa. He was previously Chief Engineer, Tinius Olsen Testing Machine Co., Philadelphia, Pa.

George G. Manov is now Senior Chemist, Radioactivity Section, Atomic Physics Division, National Bureau of Standards, Washington, D. C.

Roy W. Crum, Director of the Highway Research Board of the National Research Council since 1928, is the 1948 recipient of the Marston Medal, awarded annually at Iowa State College to an engineering alumnus of the College in recognition of achievement in engineering. As a former member of the civil engineering faculty of the College and a research engineer at its associated Engineering Experiment Station, later as Engineer of Materials and Tests of the Iowa State Highway Commission, and subsequently in his service with the National Highway Research Board, Dr. Crum has directed and promoted extensive research and development in the use and testing of highway materials. In his current position he has expanded greatly the work and influence of the Highway Research Board, and for the past 20 years has been responsible for publication of the Board's Annual Proceedings, the largest and most complete source of information available today covering latest developments in all phases of highway research.

Jerome Vergosen is now Senior Test Engineer with the Wright Aeronautical Corp., Div. of Curtiss-Wright Corp., Wood Ridge, N. J.

S. Leon Roberts, District Manager, Robert W. Hunt Co., St. Louis, was recently elected a Director of The Engineers' Club of his city. Mr. Roberts is also the newly elected Vice-Chairman of the A.S.T.M. St. Louis District Council, having been Secretary of that District from 1946 to 1948.

Harold C. R. Carlson, formerly Chief Engineer, Chas. Fischer Spring Co., Brooklyn, N. Y., has announced the opening of office of The Carlson Co., Design Consultants, in New York City, providing services for manufacturers, engineers, and inventors.

Ralph A. Sherman, Assistant Director, Battelle Memorial Institute, Columbus, Ohio, has been nominated a Director-at-large of The American Society of Mechanical Engineers.

Charles R. Ince, formerly Assistant Sales Manager, St. Joseph Lead Co., New York City, has been appointed Sales Manager, succeeding **Irwin H. Cornell,** retired after 38 years of service in the company.

Earle C. Smith, Chief Metallurgist, Republic Steel Corp., Cleveland, was the 1948 recipient of Ohio State University's Lamme Medal for meritorious achievement in engineering.

Alex. Stewart, Director of Research, National Lead Co., Brooklyn, N. Y., has been elected a Director of the Industrial Research Institute, Inc.

Charles Duncanson Young, retired Vice-President and Director of the Pennsylvania Railroad, and a Past-President of A.S.T.M., is the 1948 recipient of the Henderson Medal of The Franklin Institute of the State of Pennsylvania. Citation states it is awarded "in consideration of Mr. Young's contribution to the scientific advancement of the steam locomotive which has resulted in improving the reliability and efficiency and reducing the cost of steam locomotives thereby producing a more effective transportation unit." Presentation will be made at traditional Medal Day ceremonies on October 20.

Harold K. Work, Manager of Research and Development, Jones & Laughlin Corp., Pittsburgh, has been nominated as President, American Society for Metals; and **Arthur E. Focke,** Research Metallurgist, Diamond Chain & Mfg. Co., has been nominated for Vice-President. W. H. Eisenman, present Secretary, has the nomination for his 16th consecutive two-year term in that office, and the following are named for two-year terms as national trustees of ASM: **Harry Croft,** Director, Technical Control and Research, Chase Brass & Copper Co., Cleveland, and **Frederick J. Robbins,** Manager, Sierra Drawn Steel Corp., Los Angeles.

L. P. McAllister, formerly Assistant General Manager of the steel plants of Lukens Steel Co., Coatesville, Pa., has been named Manager. He has been with the Company since 1922.

R. W. Roush, who has served the Timken-Detroit Axle Co., Detroit, as Chief Metallurgist since 1935, has been appointed Chief Materials Engineer.

Frank J. Ross, formerly Research Chemist, Menasco Mfg. Co., Burbank, Calif., is now with the U. S. Naval Research Lab., Washington, D. C., in a similar capacity.

Ralph M. Reel has accepted an appointment as Technical Service Mgr., Dayton Rubber Export Co., Dayton, Ohio. He was formerly Factory Mgr., Pharis Tire & Rubber Co., Newark, Ohio.

Norman H. Withey is now a member of the staff of the Technical Div., Newport Industries, Inc., New York City. He was previously associated with the Alpha Portland Cement Co., Easton, Pa.

Merritt Alvin Williamson, formerly Director of Technical Research, Solar Aircraft Co., San Diego, Calif., is now with Pullman-Standard Car Mfg. Co., Chicago, Ill.

William S. James has been named Vice-President in Charge of Engineering, Fram Corp., Providence, R. I. He was previously on the staff of the Engineering Lab., Ford Motor Co., Dearborn, Mich.

Delmar G. Runner has been transferred from the Public Roads Administration, Washington, D. C., to the Non-Metals Division, U. S. Bureau of Mines, Dept. of the Interior, Washington.

Edward N. Cunningham, formerly Rubber Technologist, Stanco Distributors, Inc., New York City, is now with Enjay Co., Inc., New York, in a similar capacity.

Albert C. Holler is now Research Fellow, Naval Ordnance Research Labs., University of Minnesota, Minneapolis.

Joseph S. Coons, formerly with General Ceramics & Steatite Corp., Keasbey, N. J., is now Ceramic Engr., RCA Victor Division of Radio Corp. of America, Harrison, N. J.

Charles J. Zusi has been promoted from Technical Director to Vice-President of Container Labs., Inc., Chicago, Ill.

A. D. Wagner has succeeded J. G. Gagnon, deceased, as Chief Metallurgist, Hudson Motor Car Co., Detroit, Mich.

P. H. Dike recently resigned as Assistant Director of Research with Leeds & Northrup Co., Philadelphia; he will remain with the company as Research Consultant. Mr. Dike had served as representative of his company on several A.S.T.M. technical committees and was a member of the Philadelphia District Council.

B. L. Whittier, active in Committee D-13, has accepted an appointment on the faculty of the North Carolina State Textile School, Raleigh, N. C. He was formerly associated with the Mt. Vernon-Woodberry Mills, Inc., Baltimore, Md., as Sales Engineer.

M. G. Bell has retired as Technical Director of the Ditzler Color Division, Pittsburgh Plate Glass Co., Detroit, Mich., to be succeeded by R. I. Peters.

Gen. Donald Armstrong, recently Executive Vice-President, United States Pipe & Foundry Co., East Burlington, N. J., has been elected President, succeeding N. F. S. Russell, who has been elected Chairman of the Board of Directors and who has served as President for 25 years.

H. J. Huester, Lt. Cmdr., USNR, has been transferred from the Office of the Bureau of Aeronautics, Dayton, Ohio, to the Bureau of Aeronautics, Navy Department, Washington, D. C.

F. M. Barry is now Director of Metals Research, Scoville Mfg. Co., Waterbury, Conn., succeeding W. B. Price, recently retired. Mr. Barry has been active in various A.S.T.M. technical committees for many years.

Cleveland F. Nixon, Director of Process Engineering at the Fisher Body-Ternstedt Div., General Motors Corp., Detroit, Mich., was elected Third Vice-President of the American Electroplaters' Society during its recent 35th Annual Convention in Atlantic City, N. J. *A. Kenneth Graham,* President, Graham, Crawley & Associates, Inc., Consulting Engineers, has again been named Executive Secretary of the Society, which position he has held since 1945.

Flint C. Elder, for many years Metallurgical Engineer and Director of Research, American Steel and Wire Co., Cleveland, Ohio, and in recent years Research Engineer with the Company, has retired and is establishing a Consulting Practice in Cleveland at 3041 Edgehill Road. Mr. Elder has been active for many years in the work of A.S.T.M., notably in Committee A-5 on Corrosion of Iron and Steel, though affiliated with other committees as well.

Henry Wysor, Metallurgical Engineer on the staff of the operating Vice-President, Bethlehem Steel Co., retired from active service on July 1. Mr. Wysor, a graduate from Virginia Polytechnic Institute, had been with Bethlehem since 1918. Prior to that time he taught at Lafayette College for 14 years, the last six years serving as head of the Department of Metallurgy. He will be succeeded by John K. Killmer, who has been with Bethlehem in various capacities since his graduation from Lehigh University in 1923. For the part two years Mr. Wysor has served as Secretary of Committee A-1 on Steel and he has served on several other A.S.T.M. technical groups. He will continue to make his home in Easton, Pa.

NECROLOGY

LAURANCE BOWEN, President and Director, Pecora Paint Co., Philadelphia, Pa. (August 30, 1947). Representative of company membership.

ALLAN WADSWORTH CARPENTER, Retired Engineer of Bridges, New York Central Railroad (April 21, 1948). A native of Port Henry, N. Y., and resident of Johnstown, N. Y., for many years, Mr. Carpenter received his engineering training at Case School. His membership in A.S.T.M. dating from 1908, he was numbered among this year's Forty-Year Members. As a member of various technical committees, representing both the New York Central lines and the American Railway Engineering Association, Mr. Carpenter had participated throughout the years in the Society's activities, rendering especially capable service as Chairman of the Structural Steel Subcommittee of Committee A-1 for 14 years. He was associated with the New York Central R. R. Co. and its corporate predecessors for 43 years, in the capacities of Assistant Engineer in Bridge Department, Supervisor of Bridges and Buildings, Division Engineer, Engineer of Structures, Assistant Valuation Engineer, and Engineer of Bridges. In addition to A.S.T.M., Mr. Carpenter was affiliated with many organizations, being a life member of A.R.E.A. and a member of its Committee on Iron and Steel Structures for over 30 years, and a life member of A.S.C.E.

G. E. CLARK, Cummins Engine Co., Columbus, Ind. (February, 1948). Representative of his company since 1943 on Committee A-3 on Cast Iron.

FRANK ORVILLE CLEMENTS. 111 North West St., Westerville, Ohio (May 7, 1948). Member since 1905.

The esteem and affection in which Dr. Clements was held is in part indicated by the fact that he had received two of the Society's highest honors. He was President during the period 1931–1932 and he was elected an Honorary Member of A.S.T.M. in 1938. Associated in his early work with Dr. Charles B. Dudley, the first President of A.S.T.M., at Altoona with the Pennsylvania Railroad Co., he was later Chief Chemist and Engineer of Tests of the National Cash Register Co. in Dayton, and later Director of Research, Dayton Metal Products Co., and from 1920 until his retirement in 1939 he was Technical Director, Research Laboratories of General Motors Corp., Detroit. Keenly interested in the work of A.S.T.M., he was Chairman of the Detroit District for a number of years and did a great deal to stimulate interest in A.S.T.M. work in that area. Dr. Clements was particularly concerned with the research phase of the Society's activities and by personal gifts and through his addresses and contacts stimulated the growth of the A.S.T.M. research fund. He was most anxious to help the younger engineers and scientists and took a most active interest in Otterbein College. Following his retirement from General Motors he devoted much time and attention to work of the school and was President of the Board of Trustees. In his death the Society loses one who contributed greatly to the advancement of its work and who left an indelible imprint on its activities.

HOWARD H. CRAVER, Manager, Chemical Div., Pittsburgh Testing Laboratory, Pittsburgh, Pa. (June 6, 1948). As representative of one of the P.T.L.'s company memberships since 1915, and representative of the Laboratory on several technical committees, *i.e.*, Committee A-9 on Ferro-Alloys, D-5 on Coal and Coke, D-11 on Rubber and Rubber-like Materials, and others, Mr. Craver had rendered helpful service to the Society in many ways during the past 20 years. He had been associated with the P.T.L. for 50 years. A member of the American Chemical Society, Mr. Craver served as editor of the society's publication in Pittsburgh, *The Crucible,*

for the last 21 years. He was also a member of the American Roadbuilders' Association, the American Ceramic Society, and the American Wood Preservers' Association.

HENRY C. FREY, Chemist and Superintendent, Patek Bros., Inc., Milwaukee, Wis. (June 2, 1948). Representative of Patek Bros. membership since 1922.

LAWFORD H. FRY, recently retired as Director of Research, Steam Locomotive Research Institute, New York City (home address, 15 Wales Place, Mt. Vernon, N. Y.) (July 10, 1948). Member since 1905.

In the death of Mr. Fry the Society loses a member who for almost 50 years had been vitally interested and active in many phases of A.S.T.M. work. An outstanding authority in the field of railroad materials, and especially locomotives and locomotive design, he had been affiliated for many years with the Baldwin Locomotive Works and later for almost 20 years was with the Standard Steel Works, and subsequently with the Edgewater Steel Co. He was appointed Director of Research of the Steam Locomotive Institute about five years ago.

An authority on the testing of materials, he was interested particularly, in steel and its products, and in recent years had been concerned especially with the speed of testing, on which he wrote rather extensively. Highly respected in Committee A-1 on Steel where he had a host of friends, he was an honorary member of this committee. He had received a number of honors from other societies and associations.

Mr. Fry had gone to the hospital with the expectation of undergoing an operation for an internal malady but a heart attack ensued before the operation could be performed. He leaves his wife, the former Mildred Lucinda Kolb, and five children (two sons and three daughters) by an earlier marriage.

A. B. GIBSON, founder and President of the Gibson Electric Co. ("Gibsiloy" products), Pittsburgh, Pa. (June 5, 1948). Member since 1940. Mr. Gibson rendered important service in Committee B-4 Chairman of the Section on Standardization of Contact Forms and Sizes, also in Committee B-9 as Chairman of the Section on Electrical Parts. A native of Fort Jackson, N. Y., Mr. Gibson received his engineering training at Clarkson College of Technology, and in June of last year was awarded the honorary degree of Doctor of Engineering by his alma mater. He was associated with the Westinghouse Electric and Manufacturing Co., East Pittsburgh, from 1916 until 1929, when he was made Vice-President of the Stackpole Carbon Co., St. Mary's, Pa., remaining there until 1933 when he founded the Gibson Co. Mr. Gibson was active in civic affairs in Pittsburgh, being founder and past-president of the Pittsburgh Personnel Association, and one of the organizers of its predecessor, the Public School and Industrial Relations Association of Pittsburgh. He was also a member of the Board of Directors and a past-president of the Western Pennsylvania Industrial Conference.

MAURICE L. MACHT, Chemical Engineer, Technical Service, E. I. du Pont de Nemours and Co., Inc., Plastics Dept., Arlington, N. J. (Suddenly, July 16, 1948). Member since 1945, and as representative of his company an active participant since 1939 in the work of Committees D-9 on Electrical Insulating Materials and D-20 on Plastics, rendering valuable service in these groups.

JOSEPH J. MATTIELLO, Vice-President and Technical Director, Hilo Varnish Corp., Brooklyn, N. Y. (May 16, 1948). Representative of Hilo Corp. membership since 1934, and a member of Committee D-1 on Paint and Committee D-17 on Naval Stores. An internationally known leader in the paint and varnish industry, Dr. Mattiello was the 1946 A.S.T.M. Edgar Marburg Lecturer, his subject being "Protective Organic Coatings as Engineering Materials." He had been associated with the Hilo Varnish Corp. since 1925. He was a member of the Association of Research Directors, Sales Executive Club, Metropolitan-Long Island section of the American Chemical Society, Past-President of the Federation of Paint and Varnish Production Clubs, Chemists Club, American Institute of Chemists, American Institute of Chemical Engineers, and many other professional and honorary societies both here and abroad. He was also the author of several works on paint chemistry.

An alumnus of Brooklyn Polytechnic Institute and holder of a Ph.D. from Columbia University, Dr. Mattiello served with the New York National Guard on the Mexican border in 1916, and later in service in the first World War lost his right leg. In the recent war he served three years as a civilian chemical expert assigned to the Quartermaster Corps. Last November, while attending a convention of chemists in Paris, he was decorated with the Legion of Honor for his achievements in chemistry.

ELMER LINE PEFFER, Bureau of Standards physicist and an editor of Webster's International Dictionary, Washington, D. C. (July 2, 1948). Special Adviser-Member since 1929 of Technical Committee on Methods for Density of Committee E-1 on Methods of Testing. Mr. Peffer was Chief of the Capacity and Density Section of the Bureau's Division of Weights and Measures. He had invented a device for accurate and fast capacity testing of pipettes, small tubes with a bulb in their centers, used for making blood tests, which device he donated to the Bureau. He was also one of three special editors in the field of weights and measures for the Webster dictionary, and writer of numerous scientific papers.

JOSEPH STEWART GLEN PRIMROSE, Chief Metallurgist, The Rover Co., Birmingham, England (October 2, 1947). Member since 1917.

HENRY H. QUIMBY, Consulting Engineer, 4951 Pine St., Philadelphia, Pa. (June 24, 1948). Affiliated with the Society for forty-five years, Mr. Quimby was a member of the Executive Committee from 1930 to 1932, and contributed notably to the Society's activities for many years as a member of the committees on Steel and Reinforced Concrete. Prior to establishment of his own office as consultant in 1924, he was associated for twenty years with the City of Philadelphia Engineering Dept., serving successively as Asst. Engineer of Bridges in the Bureau of Surveys, and Chief Engineer, Department of City Transit. Designer of 60 bridges, including the Philadelphia Walnut Lane span, Mr. Quimby was a Past-President of the Philadelphia Engineers Club, a life-member of the American Society of Civil Engineers and a member of The Franklin Institute.

HALDEN M. TOMPKINS, Head, Works Control Lab., National Carbon Co., Inc., Fostoria, Ohio (February 17, 1947). Member since 1935.

W. W. TROXELL, Assistant Chief of Laboratories, The Glenn L. Martin Co., Baltimore, Md. (January 27, 1948). Representative of Martin Co. membership since 1945.

C. L. VAN FLEET, Stone Publishing Co., Dobbs Ferry, N. Y. Consulting Member of Committee C-18 on Natural Building Stones since 1946.

J. Z. WINDER, Engineer, The Richmond Fireproof Door Co., Richmond, Ind. (September, 1947). Member since 1943. Alternate for J. F. Peelle on Committee E-5 on Fire Tests of Materials and Construction.

Notes on Laboratory Supplies

Catalogs and Literature; Notes on New or Improved Apparatus

This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature:

American Instrument Co., Inc., 8010 Georgia Ave., Silver Spring, Md. A new 274-page catalog of scientific instruments describes numerous pieces of apparatus for use in chemical, biological, physical, metallurgical, engineering, and materials testing laboratories. The publication is profusely illustrated and includes comprehensive data on general laboratory equipment. Included are many special features not ordinarily found in catalogs of this type, and which are of special interest to laboratory workers in general.

Eastman Kodak Co., Sales Service Division, Rochester 4, N. Y. Two new pamphlets listing selected references on photomicrography and electron micrography have been published by this company. References on types of photomicrography and their uses are contained in a 16-page booklet; references on Fields of Application of both photomicrography and electron micrography are contained in a 32-page booklet.

The Baldwin Locomotive Works, Philadelphia 42, Pa. Bulletin 262 entitled "Stress-Strain Recorders and Strain Followers" a new 32-page catalog, describes, with pictures and diagrams, the basic principles of the various types of Baldwin recorders; gives the distinguishing features of 24 different recorders for all common makes of testing machines; and describes more than 50 extensometers, compressometers, and deflectometers that can be used with the recorders. The bulletin also shows typical stress-strain curves as produced by recorders, includes common testing accessories and four types of strain gages.

The Baldwin Locomotive Works, Testing Equipment Department, Philadelphia 42, Pa. Bulletin 282, four pages, 8½ by 11 in., describes and illustrates Baldwin-Tate-Emery Universal Testing Machine Models 20-35 and 60-35 with respective capacities of 20,000 and 60,000 lb. These machines apply and measure loads hydraulically using precision lapped-ram construction in conjunction with three-range Tate-Emery Null Method Dial Indicators. The Bulletin describes the principles of operation, the accessories, and gives specifications.

Dow Corning Corp., Midland, Mich. A 14-page pamphlet entitled "Dow Corning Silicone Mold Release Agents" gives information on the general properties of these products, as well as major applications in the fields of lubricating tire molds, and curing bags, and in the lubrication of mechanical rubber goods, floor tile, and plastics. Illustrated.

Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa., and Eimer & Amend, 635 Greenwich St., New York 14, N. Y. "Laboratory Specialties," a 40-page book, has been published to present under one cover for the first time the instrument, apparatus, chemical and furniture items designed by and available from these companies. Profusely illustrated, the book pictures 268 laboratory innovations and describes more than 300 equipment items that have been developed to aid laboratory work.

North American Philips Co., Inc., 100 East 42nd St., New York 17, N. Y. A four-page folder, "Geiger Counter Tubes—Alpha—Beta—Gamma—X-ray," lists a wide variety of NORELCO geiger counter tubes. The folder lists the type, operating temperature range, operating voltage, background counts, minimum life expectancy, price, etc.

Photovolt Corp., 95 Madison Ave., New York 16, N. Y. A four-page folder "Photovolt—Photoelectric and Electronic Measuring Instruments." Describes the Lumetron Photoelectric Colorimeter, Universal Photometer, Electronic Photometer, Transmission Densitometer, Photoelectric Reflection Meter, Glossmeter, Electronic pH Meter, and other instruments. Illustrated.

E. H. Sargent & Co., 155–165 E. Superior St., Chicago 11, Ill. The first issue of "Scientific Apparatus and Methods" has just come off press. This publication has a three-fold purpose: one, to present original articles of interest to the chemical profession; two, to present new and interesting laboratory apparatus; and three, to provide a supplement to the company catalog which will keep customers abreast of the trend in equipment changes by indicating items that have been discontinued, reinstated or changed as to their physical specifications. This publication will be issued quarterly; page size—8½ by 11 in.; Summer, 1948, edition, contains 32 pages. Subjects covered include conjunctive use of electrodeposition and polarography; assembly of an instructional polarograph; reproducibility of polarographic curves; stirring seals; assembly support system.

Scientific Glass Apparatus Co., Inc., 49 Ackerman St., Bloomfield, N. J. A 20-page pamphlet entitled "What's New for the Laboratory." Number Five in the series lists and describes and illustrates all kinds of equipment including autoclave, balances, Todd silent burner, flasks, mixers, thermometers, stirrers, scales, and others.

Instrument Notes:

Zircum Combustion Tubes—Burrell Technical Supply Co., 1942 Fifth Ave., Pittsburgh 19, Pa. Zircum combustion tubes, a development of the McDanel Laboratories, are recommended for combustion methods or other types of work requiring gastight tubes for temperatures up to 2900 F. Made from pure zirconium silicate, the tubes are fixed at their melting point (3100 F.), thus assuring at high temperatures maximum service without distortion. Zirconium silicate is a highly refractory material having a thermal coefficient of expansion of about one-third that of pure silica. Consequently, the Zircum tubes have excellent resistance to heat shock. They are smooth, straight and true to both bore and wall thickness. They are available in a variety of lengths and diameters to suit individual requirements.

Stainless Steel and Bronze Saybolt Viscosity Tubes—The Koehler Instrument Co., 168-56 Douglas Ave., Jamaica 3, N. Y. These tubes have either the threaded type or the bushing type orifices. The bronze tubes are superior to those of brass, because they impart a longer life to the tube and also due to the hardness of the alloy. The tubes are nickel plated externally to prevent erosion, should water be used as a bath medium. The gallery is also nickel plated to the overflow rim of the tube. Stainless steel tubes are highly polished externally as well as internally. The orifices for all tubes are of hardened stainless steel, lapped to the greatest precision, assuring a constancy of efflux time, and are interchangeable in any of the tubes they manufacture.

Farrand Photoelectric Fluorometer—Farrand Optical Co., New York, N. Y. This new Fluorometer has a wide range of sensitivity selection 100 to 1000 times greater than similar instruments. It has been developed and designed for use with either micro or macro volumes of solutions and is capable of measuring concentrations as low as one part per billion in volumes as small as ½ cc. of fluorescent substances. The instrument is particularly suitable for quantitative analysis of fluorescence of vitamins such as thiamin, riboflavin, etc.; quinine, atabrine, porphyrin, and other fluorophors; metal complexes, oils, drugs, pharmaceuticals, organic, inorganic compounds, etc.

Five New Spectrographic Accessories—Densitometer, Spectrum Plate Projector, Safety Arc and Spark Stand, Electrode Shaper, and Briquetting Press—Bausch & Lomb Optical Co., 636 St. Paul St., Rochester 2, N. Y.

The Densitometer permits direct reading and/or continuous recording of the density of the lines in an analytical spectrum, for determining quantitatively any element present in the specimen.

The Spectrum Plate Projector aids identification of unknown elements in any specific material or specimen. A special mirror arrangement throws the spectral image on a screen built into the projector, or onto a wall screen when greater magnification is desired for observation by a group. The spectrum of the specimen being analyzed may, in either instance, be easily compared with a known spectrum to determine alien elements present. The instrument's built-in screen is also adjustable to provide desired changes in magnification.

The Safety Arc and Spark Stand was developed to insure protection in using the high voltages (two to 10 amperes at 110 to 15,000 volts) needed to burn the specimen in the arc for spectrographic analysis. The "live" parts of the circuit are encased in a cylindrical chamber. Thoroughly insulated, the chamber is inaccessible from the outside, except by means of a door, opening of which automatically breaks the electric circuit.

The Electrode Shaper, resembling a miniature lathe, has a rotatable turret equipped with adjustable cutters, drills, and tools for shaping graphite rods into

the various standard electrodes used as arc and spark excitation sources.

THE BRIQUETTING PRESS, which looks not unlike an old-fashioned coffee-grinder in modern dress, compresses powdered drugs, chemicals, plant ashes, drill chips, hacksaw dust, and the like, into pellets about the size of an aspirin tablet. The pellets can then be easily introduced into the graphite rods prepared on the electrode shaper for burning in the arc and spark stand. Operated manually, little effort is required to produce pressures up to 16,000 pounds to compress the material into pellets.

BRINELL HARDNESS READER—Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4, Mich. This instrument is constructed to fit conveniently into the grip of a person's hand. The dial of the unit is calibrated to read in Brinell hardness numbers. Two standard dial calibrations are available; one for the 10-mm. ball diameter with 3000-kg. load and the other for the 10-mm. ball diameter with 500-kg. load. Brinell Hardness Readers with special dials for other ball diameters and loads are made to order. The Brinell hardness impressions are made in the usual manner with a Brinell tester. The next step is to press the Brinell Hardness Reader against the piece under test so that the ball point of the Reader enters the impression. The hand of the Reader will point to the correct Brinell hardness number without the use of a conversion table. This Reader is very satisfactory for use in plants or laboratories where speed and accuracy are desired. The surface at the impression may be machined, rough ground, or left as cast.

NEW LAUNDER-OMETERS FOR RESEARCH TESTING—ATLAS ELECTRIC DEVICES CO., 361 W. Superior St., Chicago 10, Ill. Two new Launder-Ometer models have been developed. The large capacity of these new machines makes them ideal for laboratory research in testing color-fastness of dyestuffs and launderability of materials. Model L1Q has a capacity of 20 pint or 20 quart jars; Model L2Q will accommodate 20 pint, 20 quart, or 6 half-gallon jars. Both units are available with vari-speed drive unit for operation between 10 and 50 rpm. These new Launder-Ometers are consistent with the high standard of manufacture set by the thousands of Weather-Ometers, Fade-Ometers, and Launder-Ometers now in use throughout the world for all types of testing.

GYCO-PHEN ELECTRONIC TEMPERATURE CONTROL—SCIENTIFIC GLASS APPARATUS CO., INC., 49 Ackerman St., Bloomfield, N. J. This is an entirely new and unique instrument which regulates power flow into electrically heated devices according to temperature variations. Unlike any transformer or cyclic timer, it may be preset to reach and maintain any desired temperature within the range of 0–500 C. Its rated sensitivity is plus or minus 0.25 C., although in normal usage such external factors as insulation, circulation, and rate of heat transfer may cause a deflection of one or two degrees from the selected temperature. Fully portable, it may be moved about the laboratory and quickly connected to various apparatus needed. No charts or calibrations are needed to operate this new instrument. The dial for temperature control reads directly in degrees centigrade. This instrument may be used wherever temperature variation may be the actuating force. As examples, the control of ovens, hot plates, water baths, Gyco and Glas-Col Heating Jackets, heated molds, and other similar heating devices is suggested.

AEROVOX INTERFERENCE FILTER—AEROVOX CORP., New Bedford, Mass. In a sturdy metal cabinet with rigid side handle and with hinged-cover compartment holding the assortment of connecting cords, plugs, receptacles, and clips, the Selector goes out on the job. There it is readily connected in various ways with the noise-producing appliance or equipment. The knob is then turned through the series of different settings, each bringing into circuit the same circuit elements as found in Aerovox Interference Filters of corresponding type numbers. Thus the type filter to use, as well as the best connections, is immediately known, and the permanent installation made accordingly.

A NEW CLOUD AND POUR TEST UNIT—Bowser, Inc., Refrigeration Division, Terryville, Conn. This unit is unique in that two more temperature factors +77 F., +118 F., and an adjustable factor from −60 F. to −80 F. for determination of very low pour points have been provided for complete testing in one unit. Stainless steel tanks contain 32 copper sleeve test tube inserts with four sleeves from −60 F. to −80 F., eight at −30 F., eight at 0 F., eight at +30 F., two at +77 F., and two at +118 F. Temperatures are controlled by built-in thermostats. The cabinet measures 52 in. wide by 39 in. high by 27 in. deep. Current required, 110 volts, 60 cycles, S.Ph., A.C. Refrigeration is provided by a self-contained, two-stage, air-cooled condensing unit.

NEW WILDER TOOLMAKER MICROSCOPE—George Scherr Co., Inc., 200 Lafayette St., New York 12, N. Y. A new folder describing this instrument has just been published by the company. It points out the numerous advantages of employing microscopic measuring for checking threads, angles, tapers, bevels and virtually all types of measurements that are common in the machine shop and metal working plants. Full specifications and dimensions and a table showing the coordinate measurements possible are included. The literature presents a well-rounded discussion of the use of a toolmaker's microscope.

BAUSCH & LOMB PHOTOMICROGRAPHIC EQUIPMENT MODEL L—Bausch & Lomb Optical Co., Rochester 2, N. Y. Catalog E-210 describes in detail this new equipment. This medium-sized L Photomicrographic Camera and its accessories have been developed keeping in mind the specific needs of each field in which photomicrography is used. The L Camera is a compact photomicrographic department in one unit. Its supporting cabinet provides storage drawers for the accessories, the linoleum top makes a perfect working surface, and the modern design upright provides plenty of leg room for comfort when using the equipment. The equipment and its accessories permit the use of

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To the A.S.T.M. Committee on Membership, 1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below.

_____

_____

This company (or individual) is interested in the following subjects: (indicate field of activity, that is, petroleum, steel, non-ferrous, etc., etc.)

_____

Signed _____

Date _____ **Address** _____

UNIVERSAL FATIGUE TESTING MACHINE—THE BALDWIN LOCOMOTIVE WORKS, Testing Equipment Division, Philadelphia 42, Pa. This machine is a flexible, crank-stroking type in which the stroke is adjusted by a planetary gear system with an independent motor that maintains constant load by varying automatically the distance of a spindle from the center of rotation. The spindle serves as crank in activating the connecting rod and crosshead that applies fatigue stress to the part under test. It can be operated up to 250 cycles per minute. Automatic equipment for controlling and indicating load, and recording changes in stroke are contained in a separate cabinet. The load-sensitive element consists of a dynamometer ring so mounted in the traveing crosshead of the testing machine as to transmit load to the specimen. The dynamometer contains a variable air gap transformer, the output of which controls a galvanometer in the cabinet. The new machine is 12 ft. 7 in. long, 74½ in. high, and 81 in. wide.

THE "PRECISION" MERCALYZER—PRECISION SCIENTIFIC CO., 3737 W. Cortland St., Chicago 47, Ill. This instrument is used for the rapid electrolytic removal of heavy metals from aqueous solutions of reactive metals. The wide range of applied potential, 0 to 10 volts, as well as the wide range of direct current, 0 to 10 amperes, permits the fast removal of large quantities of reactive metals. In addition, the use of magnetic stirring hastens the amalgamation of the reactive metals at the mercury surface. Use of the "Precision" Renewable Surface type Mercury Cathode not only speeds up the amalgamation of the reactive metals, but also allows longer use of the Mercury Cathode before replacing the mercury; thus, more reactive metal can be removed with one charge of mercury. The "Precision" Mercalyzer is a dual apparatus. Two determinations can be made independently and simultaneously—either two amalgamations, two electro-depositions, or one amalgamation and one electro-deposition.

News of Instrument Companies and Personnel

THE C. J. TAGLIABUE CORPORATION (N. J.), formerly the C. J. Tagliabue Manufacturing Company, Brooklyn, N. Y., has announced the removal of its offices and production facilities to 614 Frelinghuysen Ave., Newark 5, N. J. Now a wholly owned subsidiary of the Weston Electrical Instrument Corporation, the firm will continue to manufacture its well-known line of TAG instruments for indicating, recording, and controlling temperature and pressure, including TAG ASTM Thermometers, API Hydrometers, and petroleum testing apparatus.

TINIUS OLSEN TESTING MACHINE CO. has purchased the one-story manufacturing building on the Easton pike, at Horsham, about four miles above Willow Grove (near Philadelphia). The building, containing 98,816 square feet of floor space, was acquired by the Firestone Company during the war from the Pitcairn Co. and was used for experimental construction work on helicopters. It adjoins the Willow Grove Naval Air Station. The Tinius Olsen Testing Machine Co. will move to the new plant from its present location at the northeast corner of 12th and Buttonwood Streets, Philadelphia, Pa. This company has been in business in Philadelphia for more than 50 years.

Pioneering manufacturers of a wide range of balancing and testing machines, the Olsen name is familiar to everyone concerned with evaluation of materials and products and its instruments and machines are used all over the world. The company was originally established by Tinius Olsen, the present head being Thorsten Y. Olsen, President, and Tinius Olsen, 2d, is Vice-President. The personnel of the company have been represented in A.S.T.M. activities for many years, and are active in numerous phases of both technical committee and A.S.T.M. District work.

Miss Gretta Scott, a specialist in spectroscopy and X-ray diffraction work, has joined the staff of Hall Laboratories, Pittsburgh chemical engineering consultants. She will apply the special techniques of X-ray diffraction and spectrographic analysis to the problems of Hall clients—boiler operators in industry who contract with Hall Laboratories for supervision of their water conditioning.

Felix Wunsch, a veteran of the engineering staff of LEEDS & NORTHRUP CO., and inventor of numerous circuits widely used in electrical measuring instruments, retired on May 7. In recognition of his long service and valuable contributions to the company and the industry, a large group of his associates honored Mr. Wunsch at a dinner in connection with his retirement, and his many friends made his last day memorable with their visits and parting gifts.

Paul V. Roth, since 1919 Shop Engineer of LEEDS & NORTHRUP CO., also retired on May 7 after nearly 46 years of service with the company. In connection with his retirement, Mr. Roth was honored at dinner by a large group of his associates, and his last day was marked by the presentation of parting gifts and streams of visitors to his office.

E. S. Ronk, Sales Manager of BOWSER, INC., Refrigeration Division, Terryville, Conn., was named General Manager of the company effective May 1, 1948. Mr. Ronk entered the employ of the company in 1943 as a purchasing agent, after serving for several years in the management of R. H. Macy and Co. of New York. He became Sales Manager in 1945, a position he will continue to occupy temporarily in addition to his new duties as General Manager.

Paul Todtschinder, formerly Treasurer and Sales Executive of The Emil Greiner Co., is now affiliated with the Koehler Instrument Co., Jamaica, N. Y., as Sales Manager.

Educated Man

FIVE standards can identify the educated man: (1) ability to use and understand his native tongue in speech or writing, in order to convey his ideas and thoughts clearly and effectively to others; (2) ability to judge, compare, evaluate, in short to criticize objectively the ideas, thoughts, and conceptions of other men, acquirement of the standards and perspectives on which to base critical appraisals of such expressions; (3) knowledge of men and their affairs; such knowledge is secured through study of our own and other people's cultures, their languages, customs, laws, religions, and history; (4) knowledge of the physical world and the universe in which he lives, meaning of course some understanding of the laws and forces of nature, ranging from astronomy to bacteriology; (5) knowledge of a profession or a vocation for the purpose of earning a living and serving God and society as a competent and morally responsible individual.—*Arthur C. Willard, President Emeritus, University of Illinois.*

To the A.S.T.M. Committee on Membership

1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send me information on membership in A.S.T.M. and include a membership application blank

(Signed)_____

Address_____

Date_____

If Doctor Marburg Came Back Today

Annual Address by the President, T. A. Boyd[1], June 23, 1948

JUST thirty years ago, at the 1918 Annual Meeting of our Society, word was received of the untimely death of Dr. Edgar Marburg. Dr. Marburg, whose name is commemorated in the important Edgar Marburg Lecture established in 1925, had been secretary-treasurer of the American Society for Testing Materials ever since its organization in 1902. Illness had prevented him from going to Atlantic City for the 1918 meeting; but he had previously organized, as one of the "leading features" of that meeting, a discussion of "Cooperation in Industrial Research." He had also prepared an opening announcement for the symposium.[2]

With Dr. Marburg's active interest n research and his recognition of its importance to our Society, what would he see if he could return today? This address is an attempt to answer that question in part, and by doing so to show something of the progress of research since 1918 in the nation and in our Society. The extent of that progress would amaze anyone who returned after an absence of thirty years, and it is hoped that an account of it may be of interest to those who hear this address. It just so happens that the period spoken of coincides exactly with the era of my own activity in the field of research. So, to some degree, I am able to answer the question proposed from personal observation.

Thirty years is long enough to be the standard measure of a generation. In Mark Twain's language it is even longer, for on one occasion he said, "By forever, I mean thirty years." Needless to say, the period has seemed to me much shorter than that.

One of the first things that would strike Dr. Marburg, if he came back today, is how greatly the utilization of research by industry has been extended during the past thirty years. Back in 1918, research by industrial concerns was only in its infancy, although even then about 300 companies are said to have had research laboratories of some kind. But, of the more than 2500 industrial research laboratories in existence today, most have been organized since the First World War. Also, many of the laboratories which did exist in 1918 have grown greatly in size since that time. The combined effect of these two developments has been that the number of workers in industrial research laboratories has increased from only about 7000 in 1920 to 135,000 or more today, which is a growth of nearly twenty-fold.[3, 4]

And so Dr. Marburg would see a great many research laboratories in the land, some large, some even huge, and some not so large. He would see that some of them are new and, to him, impressively fine, and that some are not so fine. However, he would be more interested in the men working in the laboratories than in the laboratories themselves. He would, therefore, be glad to find in industrial research today some present-day Edisons, some Marconis, some Bells, some Pasteurs, and some Baekelands.

He would see, too, that, in addition to all the research laboratories established by industry, there has been since his day a considerable increase in consulting research laboratories and in research institutes conducting investigations for industry. He would see also that today nearly 300 universities and colleges are offering research service to industry.[4]

The highest rate of growth in number of industrial research laboratories occurred in the dozen years immediately following 1918, and by 1930 there were over 1600 industrial research laboratories in the country,[5] more than half as many as today. The rapid growth during that period was no doubt due in large measure to the impulse given research by its intensive and widespread application during the years of the First World War, and to the increased realization of the importance of research which grew out of it. Now again, after the recent World War, a similar upsurge in the utilization of research by industry is under way, and it is going forward in spite of shortages of qualified personnel and of building costs that are abnormally high.

Dr. Marburg would find also, if he came back today, that the acceptance of research and the utilization of the research technique has been extended beyond the field of technology in which it developed. In the business world, for instance, research is being done on personnel and industrial relations; on production and production methods; on the market, the consumer, and marketing procedure; on economic conditions and tendencies; and on other aspects of business.[6] "It is just as important," said Alfred P. Sloan, Jr., "to apply research to all the functional activities of business as it is to the technological phases of the enterprise." Fact is that in modern business the executive who decides questions merely by the old system of snap judgment cannot long survive—or else it is the business that does not survive.

Dr. Marburg would see that, during the thirty years since his time, research has brought into being many, many new products, and that these have had a big effect upon the life of the nation. He would find a radio in every home, bringing even into the most remote places music, drama, world events, and round-table discussions—as well as singing commercials, soap operas, and the controversial blood-and-thunder

[1] Research Consultant, Research Laboratories Division, General Motors Corp., Detroit, Mich.
[2] *Proceedings*, Am. Soc. Testing Mats., Vol. XVIII, Part II, p. 5 (1918).
[3] Research—a National Resource: a Report of the National Research Council to the National Resources Planning Board, Vol. 2, Sec. 4, p. 173 (1941).
[4] "Industrial Research Laboratories of the United States," *Bulletin*, National Research Council, No. 113 Eighth Edition (1946).
[5] "Industrial Research Laboratories of the United States", *Bulletin*, National Research Council, No. 81 (1931).
[6] Research—A National Resource, III, *Business Research*, National Resources Planning Board (1941).

thriller. He wou'd see television nowadays too, bringing visual broadcasts into many homes. He would find that since his time the motion picture has learned to talk, and that many films are dressed in color as well. He would see the number of automobiles increased since 1918 by five-fold and hard-surface highways spreading like a net over all the nation. He would see that railroad trains are air-conditioned now and therefore clean and comfortable, and that many of them are powered by diesel engines. In the field of power generation he would hear much talk nowadays about jets and turbines, and about atomic energy also. He would find that aviation has become a big industry with airports and airlines covering the nation and the world. He would see in wide use synthetic rubber and synthetic textiles of several kinds, so that, for one thing, the cotton stocking has been almost completely displaced by nylon hose. In the field of medicine he would find insulin, sulfa drugs, penicillin, streptomycin, and other marvelous life-saving remedies. These are but a few of the many changes within the thirty years just past.

The multitude of new things resulting from research, and all the modifications and improvements made in old things meanwhile by the same means, have greatly changed life in America since 1918—almost revolutionized it, in fact. As an ex-farm boy, I myself am particularly aware of the extent to which life on the farm has been changed through advances in technology. Gone from farm life are the isolation, the inconveniences, the discomforts, and much of the drudgery so universal in my years on the farm.

After the Battle of Britain, Winston Churchill uttered that historic saying of his about the handful of heroic airmen who had won it. "Never in the field of human conflict was so much owed by so many to so few," he said. So also, in view of the small number of those who are and have been engaged in research and of the large magnitude of the changes and benefits which have come out of their efforts, it seems appropriate to say after the same fashion that noother such small number of men in any field of human endeavor has influenced our way of life to a greater degree. It might even be said of the modern research laboratory, as Sir Francis Bacon wrote in *The New Atlantis* about the organization for finding new things, which he imagined there and called Solomon's House, that it is "the noblest foundation . . . that ever was upon the earth."

Dr. Marburg would find though, that in spite of all this, the acceptance of research by men in industry and the understanding and appreciation of its potentialities is not by any means universal, even yet. Not more than ten per cent of business enterprises have research laboratories today. There is still a widespread belief that research is so costly and so complicated that only large organizations can afford to engage in it. That belief prevails in spite of the circumstance that, although research *is* costly in time and money, it pays its own way in the long run. If that were not so, the big company could not afford to do research either.

Experience from the first has shown that industrial research, when conducted with imagination and judgment, is in fact one of the most profitable of endeavors. Thus, Charles L. Reese of the du Pont Company, in his contribution to that symposium on "Cooperation in Industrial Research" held at the Annual Meeting of our Society back in 1918, said that an expenditure of $1,200,000 on research by his company during the period from 1912 to 1915 had resulted in savings of $14,000,000.[7] That is a return of more than ten-fold. More recently, R. P. Russell, who at the time was president of the Standard Oil Development Co., said that for each one thousand dollars spent by that organization on research and development more than fifteen thousand dollars had been added to the profits of the stockholders.[8] These are just two instances among the many that might be cited.

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The head of a concern who, because his business is not a large one, believes that he cannot afford to do research is thus not thinking straight. It is not necessary to maintain a large staff in order to do research. Not many of the research laboratories which existed thirty years ago had large staffs. Most were quite small then, but some have grown to be much larger since. And the reason they grew was because of demonstrated service to the business. A research laboratory should, in fact, always be started on a modest scale. The initial staff may be only one man. Nowadays the efforts of a small staff may readily be supplemented when desired by work in research institutes, in consulting research laboratories, and in research foundations conducted by educational institutions. In respect to the widely held but mistaken belief that small businesses cannot engage in research, C. E. K. Mees has said that in his opinion the small concern can do research with particular profit and advantage.[9] For one thing, as Dr. Mees suggests, the research director of such a company can be an active part of the management of the concern to a far greater extent than is possible in a big organization.

But the profit in industrial research is not limited to the company that does it, of course. Such research is profitable, too, for the user of the product, for the customer—and usually the customer is the one who benefits most of all. This is true in respect to the automobile, for instance, which over the years has been marvelously improved in comfort and utility, and the cost of it reduced at the same time. It is true of the electric light bulb, the efficiency of which has been multiplied by five and the cost divided by almost the same figure. It is true of radio, which, all within a few years, went from the crystal set with headphones to FM with its fine reception and freedom from static. It is true

[7] *Proceedings*, Am. Soc. Testing Mats., Vol. 18, Part II, p. 32 (1918).
[8] *Chemical and Engineering News*, February 24, 1947, p. 576.
[9] *Chemical and Engineering News*, November 24, 1947, p. 3544.

of most products of research, in fact.

Competitors, too, have sometimes benefited from research conducted by other members of their industry—although, to be sure, that is quite contrary to what is generally supposed. One instance of this is the research which yielded Freon, the nontoxic and noninflammable refrigerant containing fluorine. That research was done on behalf of Frigidaire, but it greatly benefited as well every maker of air-conditioning equipment—not to mention the people whom he serves.

What with technology adv
so rapidly as it is nowadays,
question of whether a company is doing research or not has become one of the most important items for the investor to look into when scrutinizing a company as a possible place to put some of his funds. Is the company doing any research at all? And, if it is, what is the character of that research? Is it merely the fixing or "bug-hunting" type of investigation? Or is some of the company's experimentation directed toward finding out what it is going to do when it can't do just what it is doing now? In evaluating the probable soundness of an investment in industry, the answer to these questions can be far more important than the figures on balance sheets. For today the situation in which business finds itself sometimes is like that strange country of which, in "Through the Looking Glass," the Queen said to Alice that "Here, you see, it takes all the running you can do to keep in the same place."

As he looked around today, Dr. Marburg would find, too, that research has been, and still is, under fire from certain quarters—from some of those who consider themselves socially minded. Thus, the Bishop of Ripon proposed that science take a ten-year holiday to permit social evolution to catch up with the more rapid progress of science.[10] During the depression years of the 1930's the most common criticism of science and technology was that it had thrown people out of work in factories. The unemployment, which was so serious in the early 1930's, was produced by too many inventions, it was said, chiefly through the displacement of workers in factories by labor-saving machines. It is true, of course, that many factory men were out of work during the depression years; but only a fraction of those unemployed then were factory workers. For only about 20 per cent of all those working are employed in the manufacturing and mechanical industries. Furthermore, in spite of the large changes in manufacturing methods that have been made meanwhile, that percentage has not changed very much in more than 75 years.[11] Throughout that whole period those employed in factories have represented just about 20 per cent of the nation's workers.

Experience from the first has shown that industrial research, when conducted with imagination and judgment, is in fact one of the most profitable of endeavors.

However, the percentage of those working on farms has been going down steadily during that same period from more than 50 per cent of all workers to only about 20.[11] Thus it has not been in factories at all that the big reduction in workers has occurred. It has been on the farm. It's an old, old problem, though—this one of how to keep the boys down on the farm. Horace, that old Roman author of odes and other Latin literature, who wrote just 2000 years ago, complained in one of his writings that *he* could not keep help on his farm either. But powered farm machinery and modern conveniences, along with the radio, the automobile, and in some cases even the airplane also, are helping to solve that problem.

Within the past thirty years industrial research has grown to be an industry of such size that the direction or management of research laboratories has become a profession of importance. With more than 2500 industrial research laboratories in existence, and many research institutes and foundations also, the profession of research director has become a pretty large one. It is in recognition of this development that there has been formed since 1918 the Industrial Research Institute, a national society through which the members exchange information and ideas on the organization, management, and direction of industrial research.

Over the thirty years just past, there has naturally been growth in the knowledge of how to organize and conduct research in industry. One of the things found to be of particular importance is that of picking the problems to work on. Another is that the success of industrial research depends to an important degree upon how much interest the management of the business takes in it. So it has been found important for the research director to have close contact with management—or, better still, for him to be a direct part of management. There has been growth in the understanding of how to direct research, or rather of the limitation that the course of successful research cannot be intimately directed from above, but that the function of a director of research is more that of providing proper personnel and facilities, along with such guidance and encouragement as he can give. There has been expansion also in the knowledge of how to do research: that there is no one best way, but that getting started to experiment and keeping on experimenting intelligently, in spite of failures and discouragements, is one thing that always produces results. It has come to be recognized that research is pretty largely a young man's game, and that the research laboratory that does not somehow keep on its staff a proper proportion of young men will pay for that failure in reduced productivity.

Out of experience has come, also, a better understanding of how to finance research in industry. Because ideas do not come by the year, it is not possible to keep books on forward-looking research in the same way as in other and more predictable lines of endeavor. There has been an increase in the understanding of how difficult it is to sell the output of research and of how time-consuming and costly it is to introduce new products; that in this phase a sample is always important, and that a new product cannot be introduced successfully without the collaboration of the men who de-

[10] Robert A. Millikan, "Science and the New Civilization," Charles Scribner's Sons, New York, N. Y., p. 7 (1931).

[11] Food Information Series, U. S. Dept. of Agriculture, No. 82, February 16, 1944.

veloped it, for without them the product gets either more complicated and costly or less efficient. Also, the literature of research, far from adequate thirty years ago, has since grown to be very extensive. These are but a few of the many advances in the know-how of the business of industrial research.

Nothing said above is meant to imply, of course, that there was not, even thirty years ago, an important body of knowledge about how to conduct research. That any such implication would be false is illustrated, for one thing, by the following incident. It was in that symposium on "Cooperation in Industrial Research," held at the Annual Meeting in 1918, that the late Dr. Arthur D. Little uttered his famous epigram: "There is danger in an organization chart—danger that it may be mistaken for an organization."[12]

With the extension of research in industry, it is no longer as true as it used to be that fundamental discoveries are always made by the pure science investigator, working usually in a university or similar institution. It would scarcely be possible to do as much research as is now being done by laboratories in industry without making some discoveries of a fundamental nature. And in recent years several such discoveries have come out of industrial research laboratories. A few of these, mentioned for the purpose of illustration, are the following: that the electron is a wave as well as a particle, an observation which became a cornerstone of modern physics; that refrigerating gases which are both nontoxic and noninflammable may be made if fluorine is one of the components; that a synthetic resin may act as a chemical exchange medium for softening water and for other uses; that the migration of tungsten from incandescent filaments is greatly retarded by the absence of water vapor; that the light transmission of lenses may be considerably improved by coating the surfaces with materials other than glass; that clouds may be precipitated by crystal seeding; that synthetic fibers may be greatly strengthened by orientation of the molecules through stretching in the course of manufacture, and that the brittleness so produced may be eliminated by proper treatment afterward. Other examples—just to raise the number of illustrations to ten— are ductile tungsten, chemical antiknock agents, and extreme-pressure lubricants.

In spite of all the many new discoveries made since Dr. Marburg's time, though, he would see that the unknown is still far, far greater than the known. He would see that as yet we have dug only a few small nuggets of knowledge out of the great mine which is waiting to be worked. And thus the future of the business of finding new things and of improving upon old things is still practically unlimited.

Of particular interest to Dr. Marburg would be the enlarged part which research has played and is playing in the affairs of the American Society for Testing Materials. Since one of the principal functions of the Society is "The promotion of knowledge of the materials of engineering," research has always played a part in its activities. As research activity in industry has been expanded, its utilization in the cooperative endeavors of the Society has increased to a like degree. For, of course, most of the research which advances A.S.T.M. projects is done in the laboratories of cooperating members. This is the tested method by which the committee work of the Society is done for the most part.

And so, as the activity of the Society through its technical committees has grown, and as the utilization of research by the participating companies has increased, the place of research in the cooperative work done through the Society has mounted until today it is very large indeed. Every specification or method of test in the A.S.T.M. Standards is based on a great deal of research, done mostly by laboratories of committee members who cooperated in preparing it. The most recent "Review of A.S.T.M. Research Activities" fills twelve pages of the ASTM BULLETIN.[13]

Dr. Marburg would see that the unknown is still far, far greater than the known.....that we have dug only a few small nuggets of knowledge out of the great mine which is waiting to be worked.

The place of the Society itself in the promotion of knowledge of the materials of engineering is principally in its extensive activity in providing facilities for holding meetings, and for the presentation and publication of the results of research and of the work of technical committees. At an Annual Meeting of the Society nowadays there will be scheduled between 300 and 400 meetings. Some of these are technical sessions and symposiums at which the results of research are presented in the form of papers. The publication program of the Society is therefore a very large one. In addition to the Book of Standards, it includes the annual Proceedings, and the ASTM BULLETIN, together with many separate compilations, books, and pamphlets. The meetings and publications, which are so extensive and which serve so well to keep members of the Society and its technical committees abreast of progress within the field of materials, are thus major functions of the Society, and therefore activities of the highest importance.

The Society has an Administrative Committee on Research, whose function broadly is to encourage and stimulate research activity within the Society. In trying to fulfill its function, the Society finds it needful sometimes to sponsor and to finance research on its own account. This is done, of course, only when it seems necessary to supplement in some way research being done by the organizations cooperating through it. To finance such programs, special funds have sometimes been contributed by industry. Instances of this are the work on corrosion, and that on fatigue and on the effect of temperature on metals.

With the purpose of further fulfilling its function by pursuing research on subjects of importance in the field of materials, but which are not of such immediate concern to specific industries, the Society set up many years ago a permanent Research Fund. And that is something about which I should like to say a word in closing this address, in the hope that it may fall on some

[12] *Proceedings*, Am. Soc. Testing Mats., Vol. XVIII, Part II, p. 22 (1918).

[13] ASTM BULLETIN, No. 146, May, 1947, p. 30.

receptive ears. For Dr. Marburg, if he came back today, would be disappointed in the size of the A.S.T.M. Research Fund. It amounts to only about forty-five thousand dollars. The income from the fund is thus about a hundred dollars a month; and, naturally, no more than minor searches can be financed with such a small sum.

It seems desirable, therefore, as was emphasized by Past-President Carpenter in his address at the Annual Meeting a year ago, that the principal of the A.S.T.M. Research Fund be augmented in every way possible. And, except for the addition of the entrance fees from new members, some of which are being put into it, the Fund is not now being enlarged at all. Among the ways in which the A.S.T.M. Research Fund might be increased is through contributions to it by members of the Society who may wish to help improve the position of the Society in respect to its ability to sponsor needed research.

Some members in the past have made personal contributions to the A.S.T.M. Research Fund. Among these was the late F. O. Clements, a Past-President and Honorary Member of the Society. Dr. Clements, whose passing occurred during the preparation of this address, not only made a liberal contribution to the Research Fund on his own part; he also suggested that an effort be made to boost the principal of the fund to five hundred thousand dollars. We are so far from having reached that suggested goal even today that it is still a good objective to work toward.

Men of means, and there are many such within the Society, contribute through their wills or otherwise to educational institutions for advancing the cause of education. Our Society is an educational institution. But it is more than that. It is also one which helps to gather the stuff which education is made of. And so, to those members of the Society who may be able to make contributions for the furtherance of knowledge, the A.S.T.M. Research Fund is suggested as meriting the fullest support that can be given to it.

Discussion of Paper on the Resistance to Impact Loading of Plastics[1]

L. H. CALLENDAR[2] (*by letter*).—Since the authors seem to have used as a starting point for their interesting investigation some work which I did about eight years ago on impact testing of plastics, I wish to take this opportunity of raising a few points on their paper.

The main difference between our respective researches is that the authors use unnotched test pieces whereas my work was on notched test pieces[3]. The authors have worked out various formulas which fit their results and this no doubt is the case for the particular materials used. Over a wider range of materials such as I used in my investigations, I was quite unable to find any formula to fit results for unnotched test pieces owing to the irregularity of the break in the absence of a notch, the length of the break not corresponding at all to the thickness of the specimen but being anything from 1.5 to 4 times the thickness with different pieces of the same material. It was for this reason that I abandoned tests on unnotched materials in favor of notched test pieces as being of more practical value.

It may be that on theoretical grounds the mathematical formulas given are quite correct but in actual tests with unnotched pieces of, for example, 70/30 ebonite, I always found enormous variations in the impact work figure for the same material due to variations in the length of the crack. In such cases, in order to get agreement with any given formula containing a factor corresponding to the thickness of the specimen (that is, the "*h*" in the authors' formulas) it was necessary to measure the length of the crack and this would clearly be quite impracticable over a large number of tests. The errors which I found due to this variation in length of the crack were from 50 per cent to 400 per cent with some of my materials.

In view of the above, I am in agreement with the authors that for unnotched test pieces, calculations of the impact strength based on the cross-section area are likely to be erroneous. However, with notched test pieces, under the particular conditions of testing given in my paper and for the specified dimensional ratios, temperatures and humidity quite good agreement was obtained over the range of materials tested.

The authors conclude from their tests on unnotched test pieces that the impact flexural strength and impact resistance figures calculated according to their formulas are independent of the dimensions of the specimen. This is no doubt a very valuable conclusion if it can be shown to apply to the widest possible range of materials.

The factor called "slenderness ratio" intrigues me and seems to be related for unnotched test pieces to what I have called the "anvil" factor for notched test pieces. Its limitation to a minimum value of 30 (giving an anvil factor of 9) is doubtless connected with the "uncertain range" or balance between the cohesion and sheer strength of materials, which I have discussed in Appendix B of my paper.

The authors give a curve by Marks, (Fig. 7), for the relation between the slenderness ratio and the impact resistance value for allyl resin. In this there is an enormous scatter of results amounting to a maximum of about 200 per cent and it is not improbable that this mean curve might lie in a quite different position and at a different angle for some other material using unnotched test pieces.

Nevertheless, it is of considerable value that the authors have found, in confirmation of my previous work, that there is a particular relation between the dimensions of the test piece and the distance between the supports (anvil factor) which gives impact values independent of these dimensions. For their unnotched test pieces, this value appears to be 9 whereas for my notched pieces an anvil factor of 6 appeared to be the best approximation over 900 tests. It seems then that this important factor should be taken into account in A.S.T.M. specifications and that a real advance would be registered if all modern impact testing machines, whether of the guillotine or pendulum type, were fitted with Charpy anvils adjustable to suit the thickness of the test piece.

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[1] Halvard Liander, Cyrill Schwab, and Arthur Asplund, "Investigation of the Resistance to Impact Loading of Plastics," ASTM BULLETIN, No. 148, October, 1947, p. 88.

[2] Chief Chemist, Crompton Parkinson Ltd., Malden Works, London, England.

[3] L. H. Callendar, "New Method for Mechanical Testing of Plastics," *British Plastics*, Vol. 13, No. 155, April, 1942, pp. 445-458.

Electrical Properties of Plastics[1]

By A. J. Warner[2]

MANY of the outstanding advances in the electrical and electronic fields made in the past few years would have been impossible had the plastics industry not been in a position to supply or to develop the various insulating materials necessary. It would be invidious to single out any particular plastic material, since nearly all of them found application, but the vinyls, polyethylene, polystyrene, polybutene various laminates, and polyester resins played major roles. Although all plastics are essentially insulators, or nonconductors of electricity, a very wide range of electrical properties is to be found among them and nowadays it is just as important for the plastics technologist to be familiar with the dissipation factor and dielectric constant of the materials in which he is interested as it is for him to know the heat distortion point, the tensile strength, and the ability to withstand outdoor weathering.

Many articles have been written giving the electrical properties of various proprietary plastics, and from these the technical man can obtain approximate values for such parameters as dissipation factor, arc resistance, and so forth. It is not intended in this discussion that we should make a recapitulation of such data. Rather it is intended to show how the electrical properties of the materials in which we are interested are dependent on a number of factors, what changes can occur or can be made to occur, and how a better understanding of the behavior, mechanical as well as electrical, can perhaps be achieved by the use of electrical test procedures.

The two electrical properties most commonly quoted and measured are the dissipation factor and dielectric constant. The dielectric constant (ϵ') is defined as the ratio of the capacity of a condenser with the dielectric material placed between the two metallic plates acting as electrodes, to the capacity of the same arrangement of plates in a vacuum at the same temperature. The choice of the term "constant" in this respect is unfortunate, as the parameter may change quite markedly with the test conditions of frequency and temperature. The loss factor (ϵ'') is equal to the product of the dielectric constant and the cosine of the phase angle, θ, between the voltage impressed on, and the alternating current flowing in, the material under examination placed between suitable metallic electrodes. The ratio ϵ''/ϵ' is the dissipation factor and is commonly referred to as tan δ, where δ is 90 deg. minus θ, whereas the power factor is given strictly by sin δ = cos θ. It can be seen, however, that for small values of ϵ''/ϵ', dissipation factor, tan δ, and power factor are for all practical purposes equal.

It is necessary at this stage to give a little background of the theory of dielectrics although a much clearer and complete picture can be obtained by studying the literature already published. It was early postulated by Maxwell that the square of the refractive index of a substance measured by visible light was equal to the dielectric constant, but Debye in 1912, was the first to give some explanation of the fact that a large number of substances possess dielectric constants greater than those calculable from their refractive indices. He explained that these substances possess molecules in which the electrical charges are unsymmetrically placed and that in an alternating electric field therefore, they tend to align themselves in the direction of the applied field. This separation of the electrical charges in a molecule forms what is termed a "dipole," and making various assumptions, Debye deduced an equation based on this concept:

$$\frac{\epsilon' - 1}{\epsilon' + 2} \cdot \frac{M}{d} = \frac{4\pi N\alpha}{3} + \frac{4\pi N}{3} \cdot \frac{\mu^2}{3kT} \cdot \left(\frac{1}{1 + i\omega\tau}\right)$$

where:

M = molecular weight,
d = density,
N = Avagadro's number = 6.06×10^{23},
α = polarizability of the molecule,
μ = permanent or dipole moment,
k = Boltzman's constant,
ω = 2π times the frequency at which the measurement was made, and
τ = the relaxation time of the dipole.

It is, we believe, apparent that τ, the relaxation time, is proportional to the internal viscosity of the material under examination, and for spherical molecules of radius α_1, the expression

$$\tau = \frac{8\pi\eta\alpha_1^3}{2kT}$$

has been derived, where η = the viscosity, and the other terms are as previously defined.

The expressions so far given have been found to hold strictly only for a limited number of very simple molecules in the gas phase, or for dilute solutions of certain polar molecules in nonpolar solvents, but the use of the Debye equation as a first approximation has yielded many valuable results. Other investigators have attempted to "revise" the Debye equation in an attempt to make the observed results fit the theory, but it must be confessed that we still do not possess an adequate understanding of these phenomena.

The first term on the right-hand side of the general expression gives the polarizability due to the displacement of charges within the atoms themselves. This value is assumed to be inversely proportional to the force binding the charges to the nuclei of the atoms and directly proportional to the number of bound electrons per unit volume. Since these charges can form in times less than 10^{-10} seconds they usually contribute a fixed amount to the dielectric constant in the electrical frequency range. For strictly nonpolar materials, for example benzene, this is the only form of polarizability present, the dielectric constant is equal to the square of the refractive index and the value is independent of frequency. For such nonpolar materials, the dielectric constant then changes only with density changes as shown by:

$$\frac{\epsilon_\infty - 1}{\epsilon_\infty + 2} \cdot \frac{M}{d} = \text{constant}$$

This affords a novel way of determining electrically any transition point in a nonpolar polymer due to sharp changes in rate of change of density, provided the method employed is sensitive enough to check such differences of dielectric constant. It should therefore be possible to determine, for example, the second order transition point of polystyrene or to study the density changes of polyethylene over a temperature range by this method.

The second term of the general equation shows that, for polar materials, the dielectric constant is dependent not only on temperature but also on frequency and the viscosity of the medium. Moreover, the theory predicts that there will

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Presented at the Symposium on Plastics at a meeting of A.S.T.M. Committee D-20 on Plastics held in Cincinnati, Ohio, March 4 and 5, 1947.

[2] Head of Dielectric Laboratory, Federal Telecommunication Laboratories, Inc., Newark, N. J.

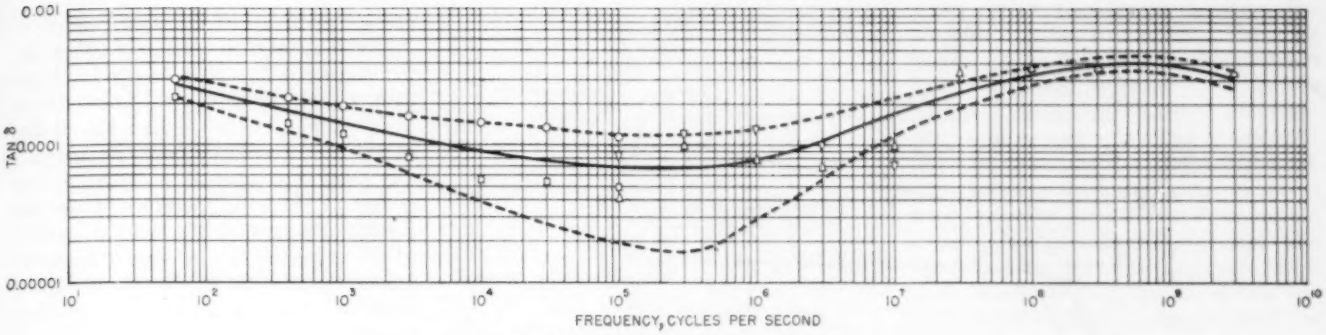


Fig. 1.—Polytetrafluorethylene at 24 C.

be a maximum in the dissipation factor which will occur at the midpoint of the change of dielectric constant from the low value at very high frequencies to the so-called static dielectric constant or the value measured by direct current. We are not proposing to deal here with the derivation of this point of maximum dissipation factor nor to show how theory fails to account for all of the observed phenomena but wish only to show how this maximum can be used to assist us in several of our plastics problems.

In addition to the dissipation factor caused by the polar nature of the molecules under investigation we often get an additional electrical loss at elevated temperatures due to the contribution of what we may term "adventitious" ionic impurities, and in many commercial plastics it is often this ionic loss which determines the usefulness of the material for electrical applications. The volume resistivity of a commercial plastic is often dependent also on this "adventitious" ionic material as will be seen later.

In order to illustrate the various points under discussion we have chosen various examples from our experience which we believe to be of general interest. First let us examine a nonpolar polymer, and for this we would use the one with the lowest electrical losses we have so far measured, namely polytetrafluoroethylene. From an examination of the X-ray and other data for this material we get a picture of a highly compact molecule comprising a rod of carbon atoms surrounded by attached fluorine atoms. The chain packing is tight, but since the molecule is essentially rod-like, it is possible to envisage a degree of freedom not normally found in high polymeric materials, namely, rotation round the axis of the molecule. Figure 1 shows the actual results of measurements of dissipation factor made on this material at a constant temperature of 24 C. and over the frequency range of 60 to 3×10^9 cycles per second. It will be seen that this material has a very low value of dissipation factor and that there is evidence of a "peak" in the 5×10^8 cycles per second range and a slight rise in value as the frequency decreases from 10^5 cycles per second. It is difficult on the basis of existing knowledge to determine the cause of the "peak" observed, although its position would perhaps indicate the presence of traces of polar material. Since this material is known to be more sintered than fused, it is possible that the low-frequency losses may be due to interfacial phenomena which are outside the scope of this present discussion. In Fig. 1 the center curve is the most probable value for the material from determinations on many samples, while the upper and lower curves give the maximum and minimum values, respectively, of the various samples.

Another interesting use of electrical measurements on this material is shown in Fig. 2 in which we plot dissipation factor at 60 cycles per second against temperature with heat cycling of a sample of sheet polytetrafluoroethylene. Heat cycling was performed from −30 to 160 C. and it will be observed that cycling causes a progressive decrease in the lower temperature values indicating again that the material is not electri-

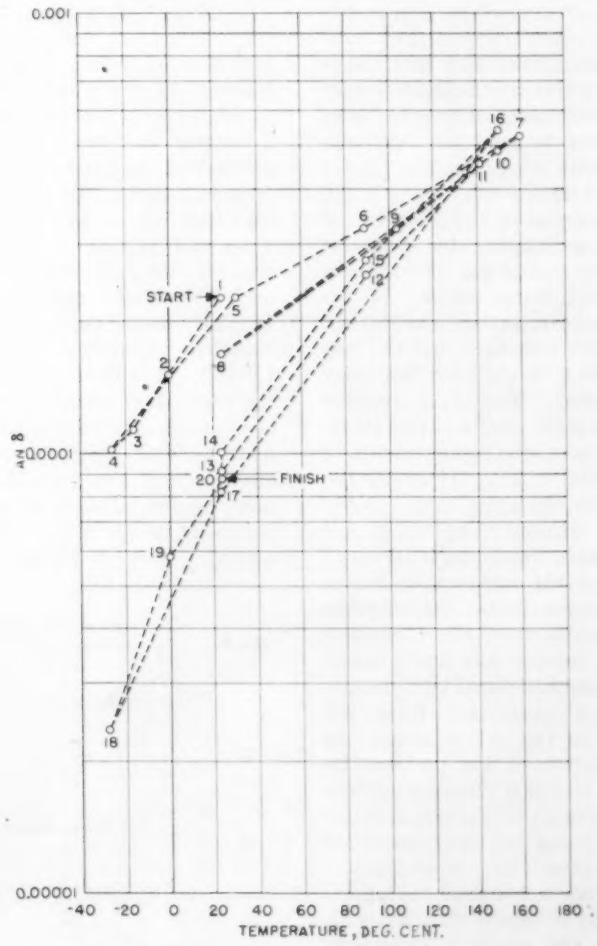


Fig. 2.—Polytetrafluorethylene at 60 Cycles per Second.

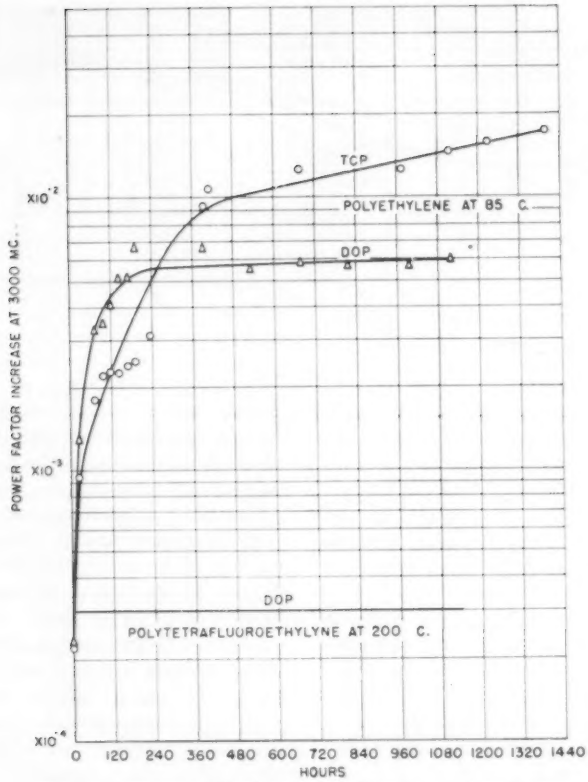


Fig. 3.—Effect of Plasticizers on Electrical Properties.

cally isotropic. Since this material is intended for use in electrical equipment over a very wide range of temperatures, it is interesting to note the relatively large coefficient of dissipation factor with temperature.

Another interesting application of electrical measurements on nonpolar materials arose during the recent war in connection with radar cables. It was observed that certain equipments lost their sensitivity with time, and this loss was traced back to the high-frequency cables employed. For these applications the dielectric used was polyethylene which has a dissipation factor of around 0.00035 at 3×10^9 cycles per second (in the operating range of the equipment). However, on aging, the dissipation factor was found to increase, especially when the cable was operating at elevated temperatures. Polyethylene by itself does not show this characteristic, and the increase was finally traced down to migration of plasticizer (usually di-2-ethylhexyl phthalate) from the vinyl jacket to the polyethylene. In finding a solution of the problem by making the so-called "noncontaminating" jacket, the use of dissipation factor measurements was the only means of rapidly detecting the migration of plasticizers from jacket stock. Figure 3 shows the kind of results obtained with polyethylene and tricresyl phosphate and di-2-ethylhexyl phthalate at 85 C. and also for comparison, a result obtained with polytetrafluoroethylene and di-2-ethylhexyl phthalate at 200 C.

Coming now to polar materials, it is interesting to study the vinyl compounds, especially those used as primary insulation or as jackets for electrical wires and cables. A study of the dissipation factor and dielectric constant of such a material is exemplified by Fig. 4 which shows the results obtained on the so-called "noncontaminating" jacket, IN-102. It will first be observed that the dissipation factor is some two and one half decades greater than a nonpolar material such as polystyrene or polyethylene and also that there is a pronounced broad peak whose maximum occurs at about 10^4 to 10^5 cycles per second. The dielectric constant decreases from a low-frequency value of 7 to a value at a frequency of 10^7 cycles per second of 3. It is not usual, however, to employ this type of material at high frequencies, and hence a knowledge of the low-frequency behavior, especially over a temperature range, is important. Figure 5, therefore, shows the results obtained on the same compound at 60 cycles per second over a temperature range of −20 to 100 C. It will be observed that on going from the low temperature to a high temperature, the dissipation factor first rises and then falls and then rises again. The first rise, giving a peak at 12 C., is due to the dipolar contribution to the loss, while the second rise, which reaches a constant rate of rise, is due to ionic materials present in the compound. It is obviously desirable to keep the ionic losses to a minimum since, as is shown in the curve, these are the chief losses at temperatures above 50 C., and therefore they tend to limit the operating temperature. In curve 4 of Fig. 5, we give the results on a compound in which we have changed the stabilizer employed to one which we have found to be more effective in preventing decomposition of the vinyl chloride acetate resin, but otherwise the composition is the same as the regular IN-102. It will be observed that the dipolar contribution to the loss is unchanged but that a marked improvement of the loss at higher temperatures has been achieved. Another possible source of ionic loss was felt to be the possibility of residual material in the plasticizer used, a resinous polyester (G-25). Initial experiments indicated the validity of this assumption and a special batch of plasticizer was prepared, paying particular attention to keeping the ionic impurities to a minimum (C-1012).

Figure 6 shows the results obtained by measuring the dissipation factor of the original (G-25) and the purified (C-1012) material at 4×10^2 cycles per second against temperature, and it will be observed that whereas the results on the purified material run parallel to those

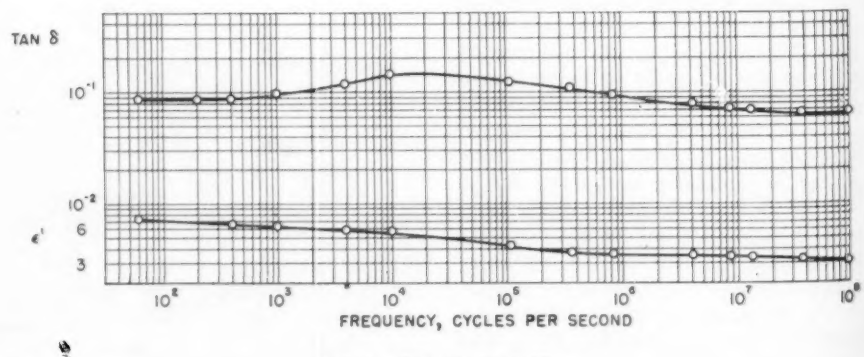


Fig. 4.—IN-102 at 30 C.

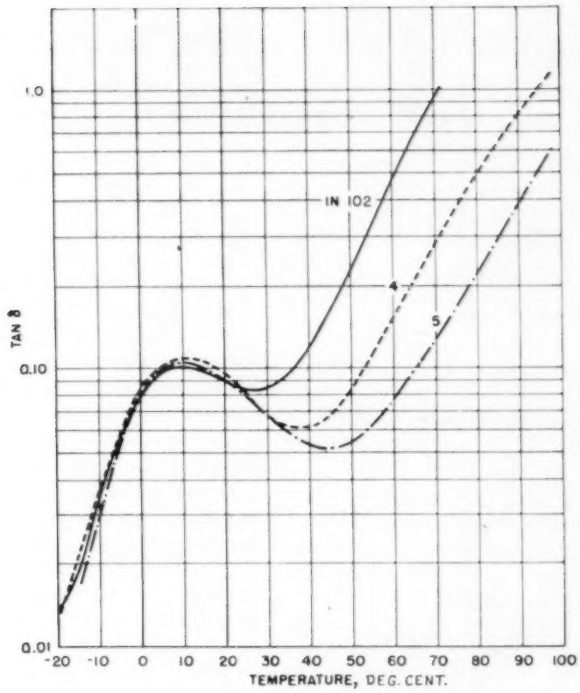


Fig. 5.—Tangent δ *versus* Temperature at 60 Cycles.

of the original material, they are in general slightly more than one decade better.

Figure 7 shows the corresponding results for measurements of d-c. resistivity, the two materials again giving parallel curves with the purified material being just over one decade superior. This indicates that the improvement in dissipation factor has been caused by the removal of ionic impurities. Curve 5 of Fig. 5 shows the results obtained when the improved stabilizer and the improved plasticizer are used, and the resulting compound is seen to have considerably improved electrical properties at the elevated temperatures over the original IN-102. We believe that these results indicate a very neat approach to the problem of testing plasticizers and stabilizers in vinyl compounds of this type.

Another problem which is very interesting both technically and technologically is that of the low-temperature performance of various semirigid plastics and the attempt to determine the behavior of such materials when applied in some fabricated form such as the extruded jacket of a cable. We are all familiar with the brittle point (A.S.T.M. Method D 746[3]) and the torsion stiffness tester (Berg and Clash),[4] but most technologists recognize that sometimes the results obtained by these tests vary from those obtained in actual performance tests. Moreover, such tests have always to be made on a compounded stock, and it is therefore not easy to study more fundamental questions of plasticizer efficiency by such tests. Some preliminary work on the possible utilization of an electrical measurement approach to this problem has been made by other investigators such as Leilich and Würstlin, who have shown in rubber and allied compounds that the more flexible a material is at low temperatures the lower is the temperature of the maximum of the dissipation factor curve at a given frequency. We have made a preliminary study of vinyl compounds and find that there is a correlation between the temperature of the dissipation factor maximum and the so-called "brittle-point." Figure 8, for example, shows the results obtained on two vinyl compounds whose dissipation factor maxima occur at 20 C. and −2 C., respectively. IN-104, with a maximum temperature of 20 C,. is a primary insulation comprising polyvinyl chloride-acetate plasticized with dioctyl phthalate and tricresyl phosphate, whereas IN-105, with a maximum temperature of −2 C., is a jacketing composition comprising the same base resin but using only dioctyl phthalate as plasticizer and in larger amounts than the IN-104. The brittle points for the two compounds are −18 C. and −42 C., respectively, and it can be seen that the difference between the brittle point values is of the same order as the difference between the temperature of the dissipation factor maxima. We have also made measurements of the temperature of the dissipation factor maximum

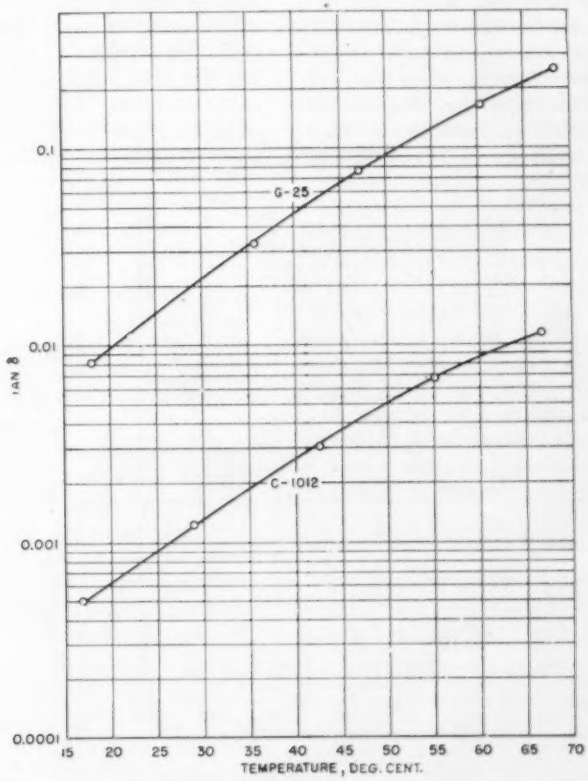


Fig. 6.—Tangent δ at 0.4 kc. *versus* Temperature.

[3] Tentative Method of Test for Brittle Temperature of Plastics and Elastomers (D 746–44 T) 1946 Book of A.S.T.M. Standards, Part III-B p. 817.

[4] R. M. Berg and R. F. Clash, Jr., "Vinyl Elastomers Low-Temperature Flexibility Behavior," *Industrial and Engineering Chemistry*, Vol. 34, p. 1218 (1942).

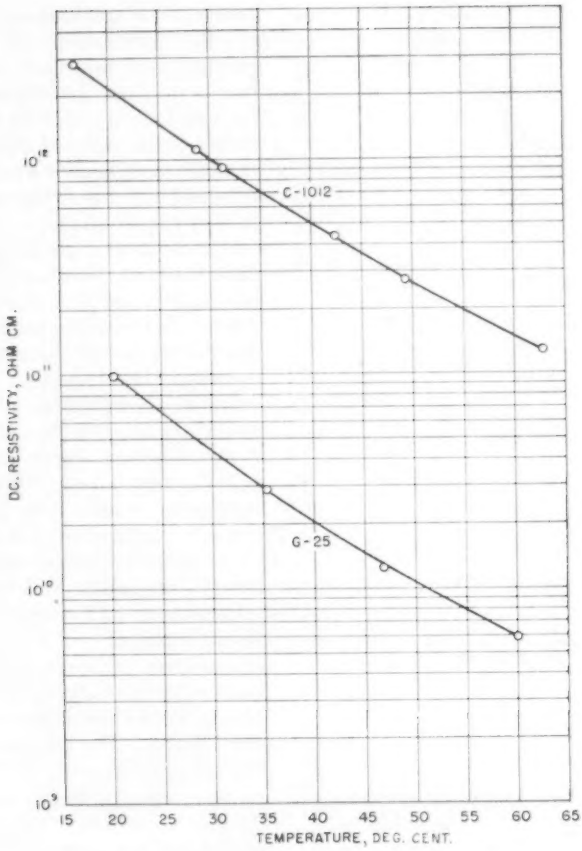


Fig. 7.—D-c. Resistivity *versus* Temperature.

of various plasticizers and the values for the same parameter measured on compounds using these plasticizers, and believe that from such data we can predict not only the low-temperature brittle points of the compounds, but also get some understanding of the efficiency of various materials as plasticizers. This phase of the work is under active study in our laboratories at the present time.

It is recognized that this discussion affords only a brief and very cursory examination of the problem of the electrical properties of plastics materials, but it is to be hoped that we have shown that electrical test methods can be effectively used in the further development of improved materials.

NOTE—Since presenting this paper at the D-20 Symposium on Plastics, additional work has been done on the use of the temperature of the dissipation factor maximum for studying plasticizer action, and it is hoped to present these data in a future paper.

DISCUSSION

MR. GEORGE E. POWER.[1]—Am I correct in the assumption that the maximum loss factor as determined on a loss factor *versus* temperature curve is the same as the maximum determined on a loss factor *versus* frequency curve?

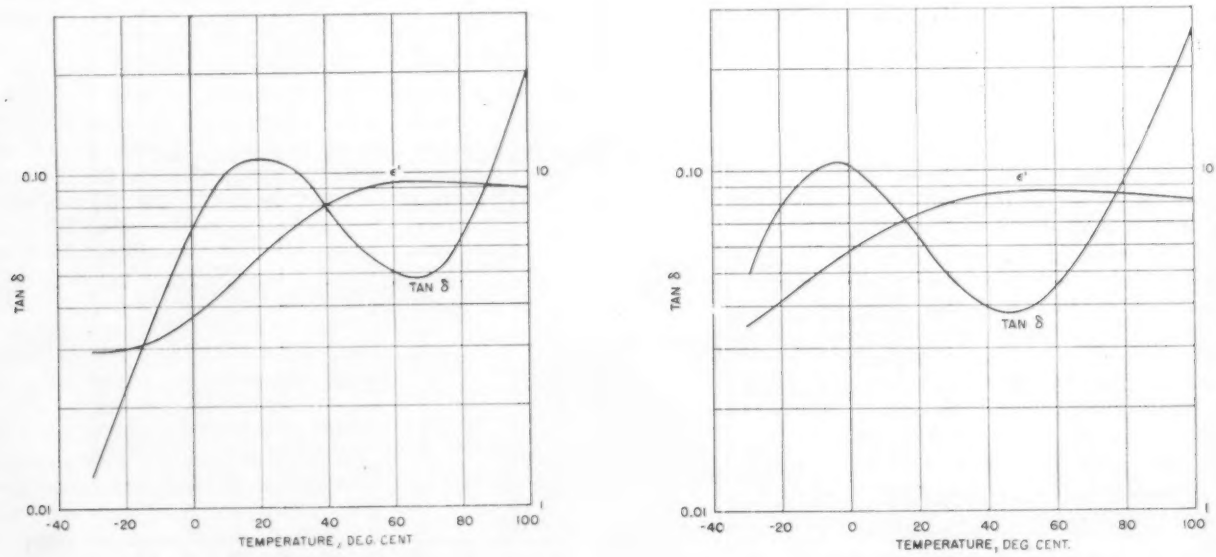
MR. A. J. WARNER (*author*).—That is essentially correct. Although the absolute values may be slightly different, the order of magnitude is the same. It is also possible to determine the frequency at which the maximum loss factor will occur from the loss factor *versus* temperature curve.

MR. POWER.—Does the frequency at which the loss factor *versus* temperature curve is determined have any effect on the maximum loss factor?

MR. WARNER.—It does not affect the order of magnitude of the maximum but it will affect its position on the curve. We have done most of our work at 60 cycles.

MR. R. L. STERN.[2]—I wonder whether Mr. Warner is familiar with a recent article, "The Dielectric Identity Test for Plasticizers," [3] which appeared in *Analytical Chemistry*, for January, 1947, and whether it could be cited here?

[1] Engineering Dept., The Formica Insulation Co., Cincinnati, Ohio.
[2] Chemical Supt., Hercules Powder Co., Parlin, N. J.
[3] By M. A. Elliott, A. R. Jones, and L. B Lockhart.



(*a*) Compound IN-104 Cream. (*b*) Compound IN-105 Black.

Fig. 8.—ϵ' and Tangent δ *versus* Temperature at 60 Cycles.

Automotive Glazing with Plastics[1]

By George B. Watkins[2] and Joseph D. Ryan[2]

THE title "Automotive Glazing with Plastics" may call to mind the time when transparent, flexible Celluloid (pyroxylin plastic) was used for back windows and side curtains of the automobile. The subject matter of this paper refers to the fairly recently developed synthetic resin plastics that have transparency and rigidity more comparable to glass. These plastics are serving the purpose of glass in certain limited applications and are under consideration for motor car glazings.

At the present time, safety glass as defined by the American Standard Safety Code Z26.1 is accepted generally by the various states for glazing motor vehicles operating on land highways. The term "Safety Glass" as defined by this code refers to "glass so treated or combined with other materials as to reduce in comparison with ordinary sheet or plate glass the likelihood of injury to persons by objects from exterior sources or by glass, when the glass is cracked or broken."

At the present time there are three types of glass which qualify under this code: namely, Laminated Safety Glass, Wire Glass, and Heat-Strengthened Glass.

1. Laminated Safety Glass.—Laminated glass is made by bonding two lights of glass together with an interposed sheet of transparent plastic. The function of the plastic, which in this application is considerably less brittle than glass, is to hold the particles of glass together when the glass is cracked or broken. Laminated safety glass is not restricted and qualifies for glazing both windshields and body lights of the motor vehicle.

2. Wire Glass.—Wire glass, familiar to all, is glass reinforced with wire. The Code restricts the use of this type of glass to body lights only, and it finds limited application for motor car glazings, such as partition lights in taxicabs, back lights of trucks, etc.

3. Heat-Strengthened Glass.—The manufacture of heat-strengthened glass consists in heating lights of ordinary glass, previously cut to the exact size, just to its softening point. It is then quickly, but uniformly, chilled by blasting with cold air. The Code restricts the use of heat-strengthened glass to body light glazing, and it is presently used extensively for back light glazing.

Prior to the recent world war some of the chemical companies had succeeded in developing a methacrylate transparent plastic sheeting which from the standpoint of light transmission and stability is acceptable for certain glazing purposes, notably for aircraft glazing. While these plastics had the disadvantage of being fairly soft and easily scratched or marred, as compared to glass, they did offer the advantage of decreased weight and could be readily and satisfactorily formed to more complicated shapes than those obtainable with laminated safety glass.

Because of the lower density of plastics and ease of fabrication into curved sections, consideration is being given to their application for glazing postwar cars. To determine or establish the suitability of plastics for motor car glazings, a study, including laboratory tests and practical glazing tests, has been made of three commercially available plastics: namely, polymethyl methacrylate plastics, including Lucite and Plexiglas, and CR-39.

For evaluation purposes, laboratory wise, these three plastics were subjected to the qualifying tests as established by the A.S.A. in the Safety Glass Code Z26.1, with the following results:

Stability Test:

A. Discoloration Test.—Specimens of Plexiglas, Lucite, and CR-39 were irradiated with ultraviolet light for 100 hr., as specified in the Code (Cooper-Hewitt Uviarc at a distance of 9 in.). While all three specimens suffered a higher loss in light transmission percentage-wise than laminated safety glass, their light transmission of 85 to 88 per cent after exposure was well above the minimum of 70 per cent required by the Code. In the Uviarc test, the CR-39 plastic did not undergo any apparent surface decomposition; however, both the Plexiglas and Lucite surfaces showed decomposition (depolymerization). For this reason, neither Plexiglas nor Lucite would pass the Code Discoloration Test requirements if a literal interpretation is made of the phrase "no bubbles or noticeable decomposition shall develop in the irradiated portion." However, it is felt, based upon normal exposures to the sun, that this type of accelerated ultraviolet light test is too severe for evaluating these plastic materials for commerical motor car glazings, since under no conditions would an automobile glazing be submitted to the intense radiation employed in this test. To further elaborate, it has been observed when a less intense source of ultraviolet radiation is employed, such as in the General Electric Sun Lamp, Plexiglas and Lucite are comparable in stability to the CR-39 plastic, even after very prolonged exposure.

B. Humidity Test.—A number of specimens of Lucite, Plexiglas, and CR-39 plastics, when placed in the 70 per cent relative humidity atmosphere required by the Code for a period of two weeks, showed no change taking place in any of the specimens, thereby satisfactorily meeting the requirements of the Code.

C. Boil Test.—Specimens of Lucite, Plexiglas, and CR-39 plastics, when immersed in boiling water for 2 hr. as required by the Code, did not develop any bubbles, but did undergo warpage, the CR-39 being superior from this standpoint to either the Plexiglas or Lucite. If warpage is to be considered as an objectionable defect in this test, all three plastics failed to meet the specification. However, there seems to be justification for contending that this portion of the test specification of the Code should be modified to evaluate plastic materials, since the Code was written around glass which at high temperatures has greater form stability.

Impact Test:

The qualifying impact tests as established by the Code for the three types of Safety Glass are listed in Table I.

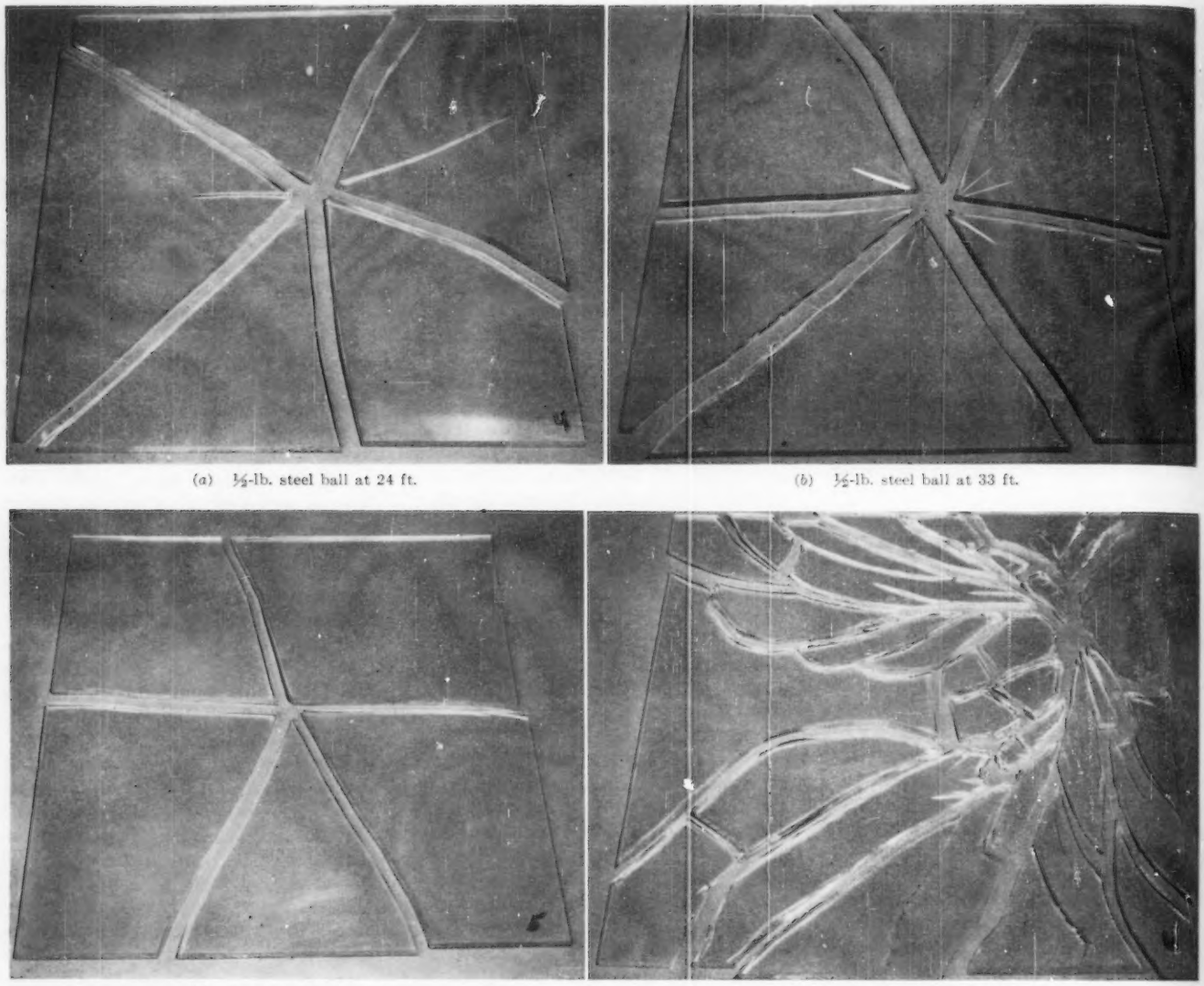
TABLE I.—SAFETY GLASS—IMPACT TEST REQUIREMENTS.

Type of Safety Glass	Kind of Impact	Requirements
Laminated	½-lb. steel ball—16-ft. drop	80% support
Laminated	7-oz. dart—10-ft. drop	100% support
Heat-strengthened	½-lb. steel ball—10-ft. drop	100% support
Heat-strengthened	11-lb. shot bag—8-ft. drop	100% support
Wire glass	7-oz. dart—10-ft. drop	100% support

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Presented at the Symposium on Plastics at a meeting of A.S.T.M. Committee D-20 on Plastics held at Cincinnati, Ohio, March 4 and 5 1947.

[2] Director of Research and Assistant Director of Research, respectively, Libbey-Owens-Ford Glass Co., Toledo, Ohio.



(*a*) ½-lb. steel ball at 24 ft. (*b*) ½-lb. steel ball at 33 ft.

(*c*) 7-oz. steel dart at 25 ft. (*d*) 11-lb. shot bag at 20 ft.

Fig. 1.—Plexiglas, ¼ in. Thick, After Impacting.

TABLE II.—PLASTICS—RESULTS OF IMPACT TESTS.

Type of Plastic	Impact Tests			
	½-lb. Steel Ball, 16-ft. Drop	½-lb. Steel Ball, 10-ft Drop	11-lb. Shot Bag, 8-ft. Drop	7-oz. Dart 10-ft. Drop
CR-39.....	1 out of 10 samples failed	No failures	4 samples tested; 50 per cent failed	4 samples tested; 1 failed
Plexiglas.....	No failures	No failures	No failures	No failures
Lucite.....	No failures	No failures	No failures	No failures

Justification for the different impact test requirements for the three types of safety glasses is found in the restrictions relative to the location heat-strengthened and wire glass may occupy for motor car glazings.

In Table II are given the results of subjecting ¼-in. thick specimens, 12 in. by 12 in. size, of Plexiglas, Lucite, and CR-39 plastics at normal temperatures to tests with the ½-lb. steel ball falling 10 ft., and 16 ft.; the 7-oz. steel dart falling 10 ft.; and the 11-lb. shot bag falling 8 ft.

Visibility Distortion Test:

A distortion test was established in the Code to determine whether objects may be viewed through the safety glass without serious distortion, applicable only to windshield glazings.

Ten samples each of Plexiglas, Lucite, and CR-39 plastics, ¼ in. thick, were examined for visibility distortion using the procedure set up in the Code, which allows a maximum deviation of 5.73 min.

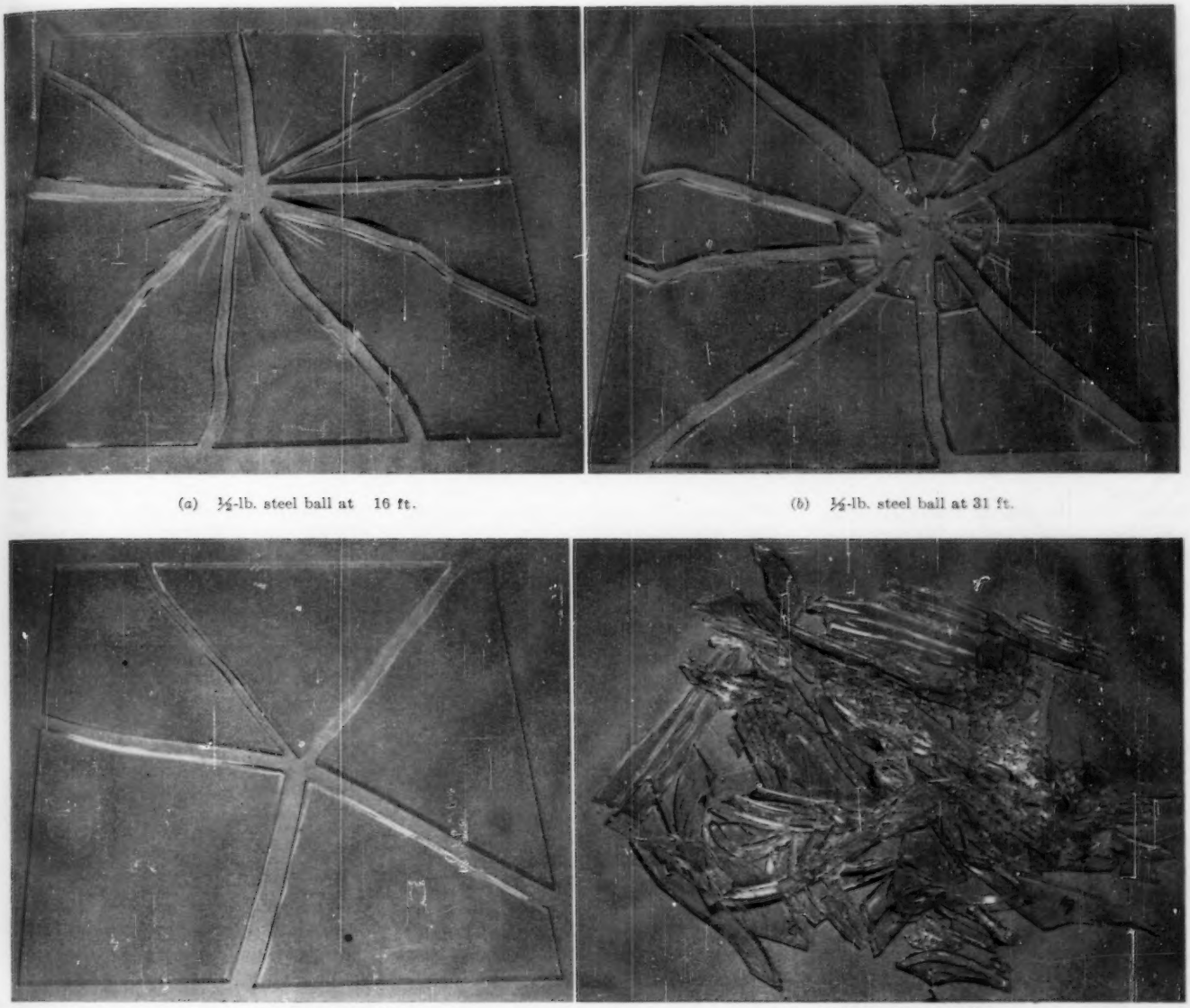
The results of our examination of the three types of plastic sheeting are given in Table III.

Abrasion Resistance of Plastics:

The Code does not place any requirement on the resistance to surface abrasion of safety glass for motor car glazing. However, when considering the use of plastics for glazing purposes,

TABLE III.—COMPARISON OF PLASTIC SHEETING TYPES.

Type of Plastic	Results of Distortion Measurements	
	A.S.A. Code Visibility Distortion Test for Windshields; Maximum Deviation, 5.73 min.	Remarks
¼-in. Plexiglas.....	3 of the 10 samples examined showed a deviation greater than 5.73 min.	The 7 samples passing the test showed deviations between 2.15 min. and 5.73 min. The 3 samples that failed showed deviations between 5.73 min. and 7 min.
¼-in. CR-39.....	The 10 samples examined passed the test	All the samples tested showed deviations in the neighborhood of 3 min. average
¼-in. Lucite.....	The 10 samples examined passed the test	Two samples showed deviations less than 2.15 min.; five samples exactly 2.15 min.; while 3 samples showed a maximum deviation of 5.73 min.



(a) ½-lb. steel ball at 16 ft. (b) ½-lb. steel ball at 31 ft.

(c) 7-oz. steel dart at 10 ft. (d) 11-lb. shot bag at 8 ft.

Fig. 2.—CR-39, ¼ in. Thick, After Impacting.

because of the relative ease of surface destruction by scratching, cleaning, rubbing, etc., it would seem desirable, if not necessary, to establish a minimum "Resistance to Abrasion Factor" for plastics.

There seems to be quite general agreement among those working in the plastic field that any test method for measuring the abrasion resistance of plastics is at best inadequate and that methods may be selected to give results favoring one product or another.

For comparative purposes, probably the Taber Abrasion Test has as few shortcomings as any method developed to date.

A. Taber Abrasion Test.—Briefly, the Taber Abraser consists of a motor-driven rotating circular disk, to the top surface of which is affixed the specimen to be tested. The instrument is provided with an arm which may be suitably weighted to impose any given desired load on the two rubber-bonded abrading wheels, which are friction driven by the specimen rotated on the table. Since the abrasive is held in a rubber matrix, and the ease with which the matrix gives up its abrading particles is a variable, and since the character of cutting edges of the abrading particles varies from one point to another on the wheel, thermoplastic materials are affected differently than thermosetting plastics. It has been observed that when the test is run over a long time interval the thermoplastic materials tend to undergo a certain amount of flow or molding, which makes them appear better than they actually are from the standpoint of abrasion resistance (polishing takes place).

TABLE IV.—PERCENTAGE OF SURFACE DESTRUCTION AS MEASURED BY LIGHT SCATTERING.

Type of Plastic	100 Revolutions	200 Revolutions	500 Revolutions
¼-in. Lucite	10.0	10.7	10.5
¼-in. Plexiglas	12.6	12.6	7.6
¼-in. CR-39	3.9	5.4	11.1
Plate glass	0	0	0

The results of testing Lucite, Plexiglas, CR-39, and plate glass by the Taber Abraser method, using a CS-10 wheel and a 500-g. load for 100, 200, and 500 revolutions are given in Table IV.

The per cent light scattering is a measure of surface destruction and is determined by Methods Nos. 1092 and 3021 outlined in Federal Specification L.P. 406A.

The results obtained during the past several years of experimental work, using every known hardness and abrasion resistance test, definitely indicate that glass is very substantially superior to any presently known transparent plastic from the standpoint of scratch and abrasion resistance; to illustrate, CR-39 plastic, recognized as the best

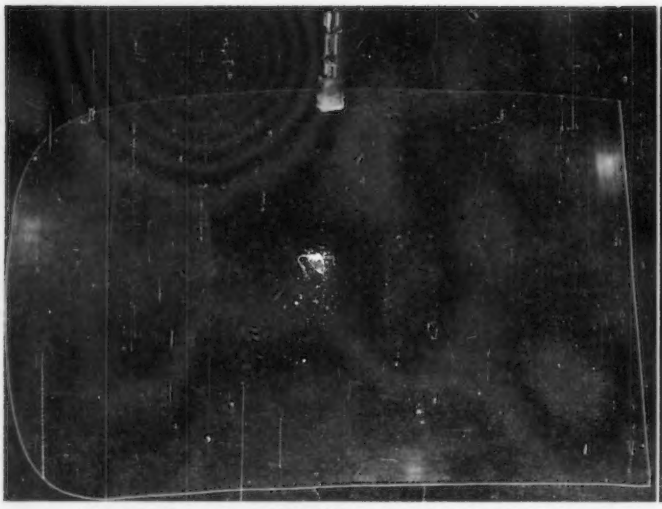


Fig. 3.—Plexiglas Half Windshield Before Glazing.

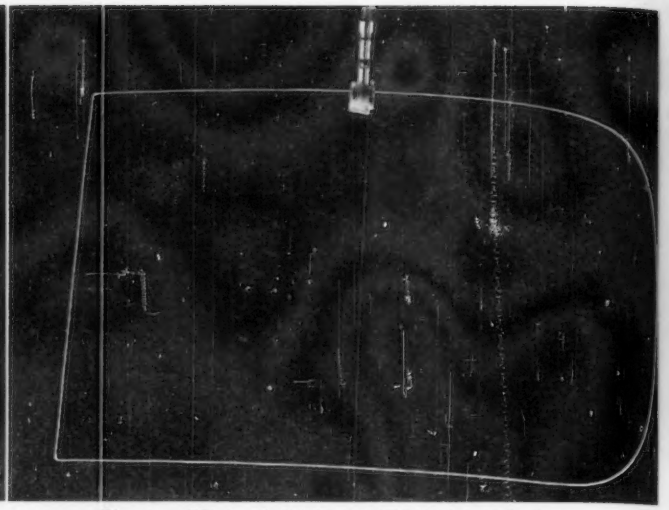


Fig. 4.—CR-39 Half Windshield Before Glazing.

today from the standpoint of abrasion resistance, is easily and readily scratched by such glass polishing and cleaning agents as rouge or Bon Ami.

Fire Hazard:

The question of the fire hazard presented by plastics as compared with glass was investigated by pouring gasoline on the surface of methacrylate plastic and then igniting it with a match. Such an event might occur in the case of gasoline being spilled over the surface of a car during an accident. It was found that while gasoline burned, the plastic did not ignite sufficiently to make the flame self-propagating. It was observed, however, that the surface of the plastic was ruined and that the sheet buckled or bowed. In case of a serious fire, the plastic would presumably burn completely, but probably not more rapidly than the car upholstery.

Resistance to Impact of Plastic Glazings:

A 26 in. by 26-in. sheet of $\frac{1}{4}$-in thick Plexiglas, supported around the entire periphery by a frame resting on the floor, was subjected to the force of a 160-lb. man jumping on the center of the panel. The panel bent, but did not break.

The above jumping test was repeated on $\frac{1}{8}$- and $\frac{3}{16}$-in. thick Lucite and Plexiglas, resulting in no failure due to breakage of the plastic panels.

The above tests serve to illustrate the strength of plastic glazings; however, it is cutomary to evaluate glazing materials by the use of standard impact tests. Therefore, instead of the above practical tests, these materials were evaluated with standard impacting objects established in the Code.

A summary of impact tests conducted on CR-39, Plexiglas, and Lucite plastics of varying thicknesses to produce occasional failures is given in Table V.

With regard to the effect of temperature on impact strength, it should be pointed out that the impact values given in Table V are typical over the range of temperature 0 F. to 120 F.; that is, over the temperature range of use, the impact strength is not materially changed. As seen from this tabulation, if plastics are to meet the Code impact tests for body lights, a minimum thickness of $\frac{1}{4}$ in. is indicated for CR-39 plastic and between $\frac{1}{8}$ in. and $\frac{3}{16}$ in. for Plexiglas and Lucite. On the other hand, if they are required to meet the Code impact tests established for laminated Safety Glass, a minimum thickness slightly greater than $\frac{1}{4}$ in. is indicated for CR-39 and $\frac{7}{32}$ in. for Plexiglas or Lucite.

TABLE V.—IMPACTING DISTANCE TO PRODUCE OCCASIONAL FAILURES.

Type and Thickness of Plastic	Impacting Distance to Produce Occasional Failures, ft.		
	½-lb. Steel Ball	11-lb. Shot Bag	7-oz. Dart
¼-in. CR-39	16	7	10
⅛-in. Plexiglas and Lucite	8	6	6
3/16-in. Plexiglas and Lucite	15	15	22
¼-in. Plexiglas and Lucite	22	20	25

The character of fracture resulting from rupture of plastics on impact is

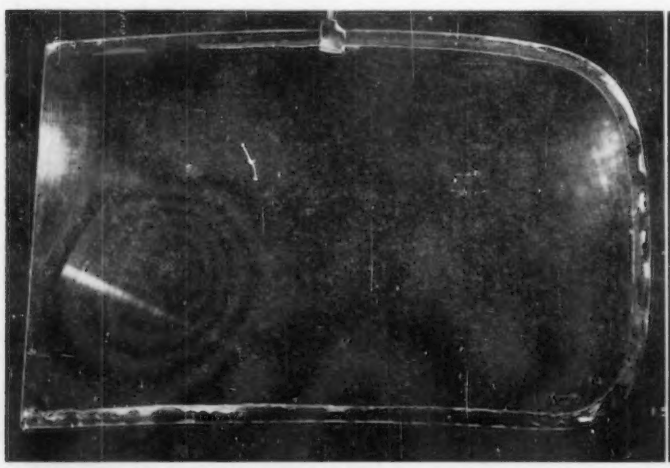


Fig. 5.—Lucite Half Windshield, Car C After 48 Days' Service.
Wiper used 2½ hr.; mileage driven, 1100 miles.

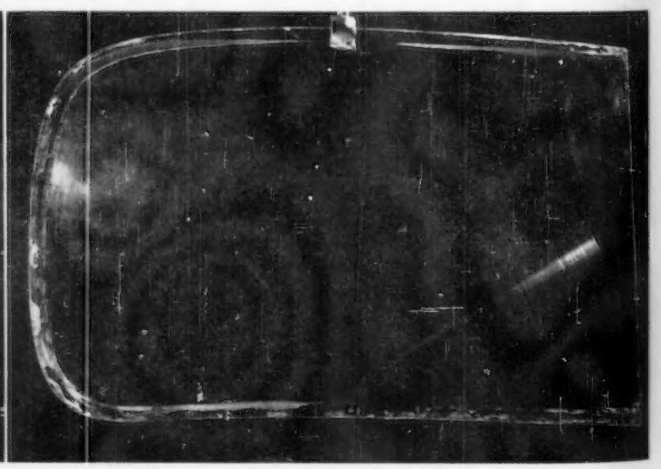


Fig. 6.—Plexiglas Half Windshield, Car C After 48 Days' Service.
Wiper used 2½ hr.; mileage driven, 1100 miles.

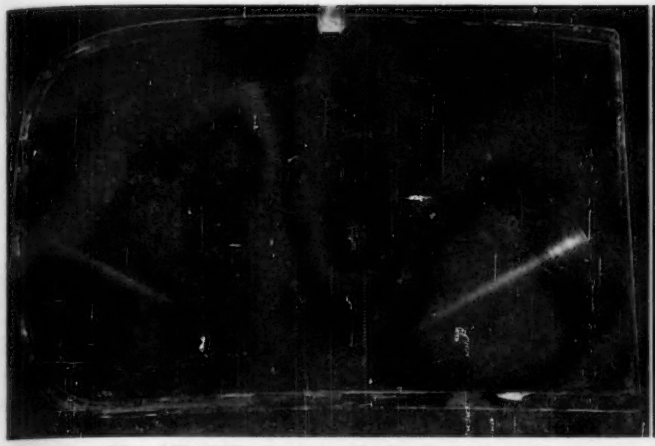


Fig. 7.—CR-39 Half Windshield, Car B after 183 Days' Service.
Wiper used 5½ hr.; mileage driven, 3700 miles.

Fig. 8.—Plexiglas Half Windshield, Car B After 183 Days' Service.
Wiper used 5½ hr.; mileage driven, 3700 miles.

shown in Fig. 1 for Plexiglas, and Fig. 2 for CR-39.

Service Tests

The results of practical service tests reported here are based upon the performance of Plexiglas, Lucite, and CR-39 Plastics glazed throughout in three 1941 Model Buick sedans, except their back light, in the following manner:

Car A

Left half windshield	CR-39
Left front ventilator	CR-39
Left front doorlight	CR-39
Left rear doorlight	CR-39
Left rear quarter light	CR-39
Right half windshield	Lucite
Right front ventilator	Lucite
Right front doorlight	Lucite
Right rear doorlight	Lucite
Right rear quarter light	Lucite

Car B

Left half windshield	CR-39
Left front ventilator	Plexiglas
Left front doorlight	Plexiglas
Left rear doorlight	Plexiglas
Left rear quarter light	Plexiglas
Right half windshield	Plexiglas
Right front ventilator	CR-39
Right front doorlight	CR-39
Right rear doorlight	CR-39
Right rear quarter light	CR-39

Car C

Left half windshield	Lucite
Left front ventilator	Lucite
Left front doorlight	Lucite
Left rear doorlight	Lucite
Left rear quarter light	Lucite
Right half windshield	Plexiglas
Right front ventilator	Plexiglas
Right front doorlight	Plexiglas
Right rear doorlight	Plexiglas
Right rear quarter light	Plexiglas

Detailed notes were kept by each car operator regarding the performance of the plastic glazings. Also, photographs were made through and of the windshields at the time of glazing and after removal to illustrate the amount of distortion, as well as surface destruction occurring in service. For comparative purposes, similar photographs were made of the laminated safety plate glass windshields.

Windshield Glazings:

The performance of plastic windshield glazings, illustrative photographs and inspection reports, are discussed and summarized below:

When distortion photographs of the three safety plate glass windshields (originally installed by the automobile manufacturer) were made just prior to their removal after three or four years' service and were compared with similar distortion photographs taken through the plastic windshields immediately subsequent to glazing in the automobiles, slightly more distortion was found in the plastic windshields than that existent in the safety plate glass windshields after several years of automobile service.

It is believed, however, that the plastic manufacturers could supply plastic commercially to meet the visibility distortion limit of 5.73 min. specified in the American Standard Code for Safety Glass for Windshield Glazings.

Surface Deterioration.—Inasmuch as the plastic windshields in all cases are subjected to the action of a windshield wiper, naturally these glazings underwent a much more rapid surface deter-

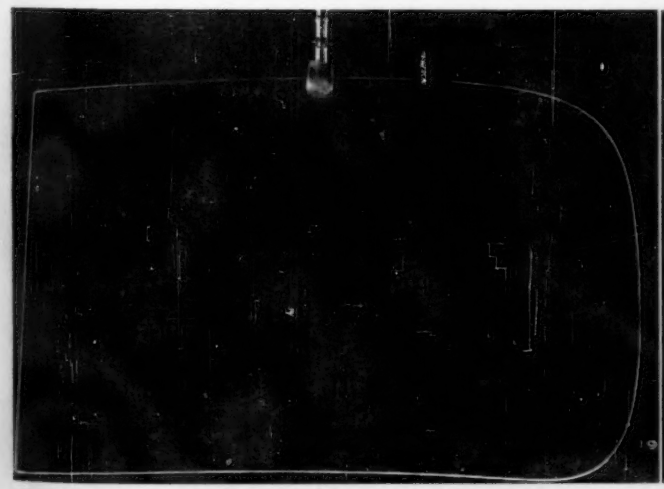


Fig. 9.—Safety Glass Half Windshield Before Glazing.

Fig. 10.—Safety Plate Glass Half Windshield After Four Years, One Month Service.
Mileage driven, 40,000 miles.

Fig. 11.—CR-39 After Service for One Year in a 1941 Buick Sedan.

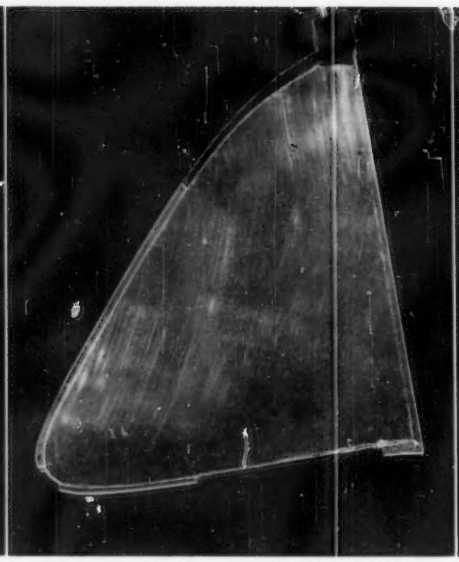


Fig. 12.—Lucite After Service for One Year in a 1941 Buick Sedan.

Fig. 13.—Plexiglas After Service for One Year in a 1941 Buick Sedan.

ioration than the ventilators and body lights. Photographs were, therefore, made of the plastic windshields as initially glazed to show surface quality and again after removal from the car.

Figures 3 and 4 show Plexiglas and CR-39 plastic half-windshields before glazing.

Figures 5 and 6 show the condition of Lucite and Plexiglas half-windshields removed from car C after 48 days' service. During this period, the windshield wipers were in use about 2½ hr.—total distance driven, 1100 miles.

Figures 7 and 8 show the condition of CR-39 and Plexiglas half-windshields removed from car B after 183 days' service. During this period, the windshield wipers were in use about 5½ hr.—total distance driven, 3700 miles.

For comparison, similar photographs were made of safety plate glass windshields, both before and after three to four years of service. Figure 9 shows a half-windshield of safety plate glass before glazing. Figure 10 shows safety plate glass half-windshields after several years of service.

From the above comparisons, it can be concluded that even after three or four years of normal service in an automobile, safety plate glass windshields are far superior to present transparent plastics after a few weeks' service.

The results of this service test seem to justify the conclusion that CR-39 has at least twice the life of Plexiglas or Lucite plastics when subjected to windshield wiper action. This was evidenced in the case of car C where it was imperative to remove both half-windshield panels in 48 days; whereas in the case of car B, the CR-39 windshield lasted 183 days. The Plexiglas half-windshield in Car B and the Lucite half-windshield in car A both deteriorated to a point where their use was intolerable in about the same period of time as in the case of car C, even though they were not removed as promptly.

Body Light Glazings:

All of the plastic body lights were removed from the three Buick sedans after one year of service. They were carefully cleaned, inspected, and representative specimens (50 per cent of the total) photographed under lighting conditions to bring out or emphasize the surface destruction which occurred as a result of service. The lighting conditions are emphasized, because even in the scratched condition depicted in the photographs, the body lights were still usable.

Inspection showed no noticeable warpage in any of the plastic body lights.

Surface Deterioration.—The examination of all of the plastic body lights, comparing the CR-39, Lucite, and Plexiglas that were glazed in comparable positions with respect to the motor car, showed little or no difference in resistance to abrasion between the Lucite and Plexiglas. The CR-39 plastic, however, was superior to both Lucite and Plexiglas from the standpoint of surface abrasion or surface destruction during the one year of service.

Figures 11, 12, and 13 showing front ventilator lights; Figs., 14, 15, and 16 showing front door lights; Figs. 17, 18, and 19, rear door lights;

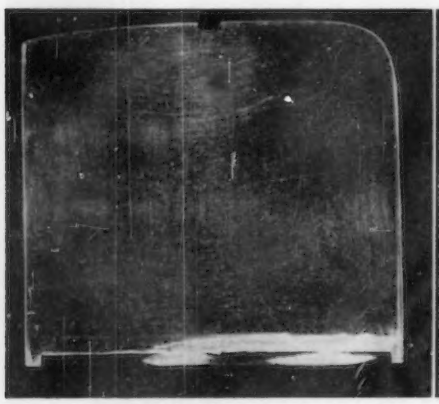


Fig. 14.—CR-39 After Service for One Year in a 1941 Buick Sedan.

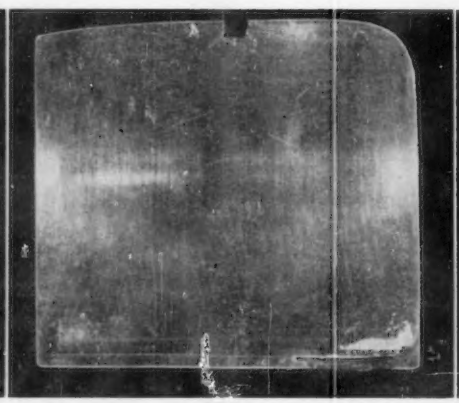


Fig. 15.—Lucite After Service for One Year in a 1941 Buick Sedan.

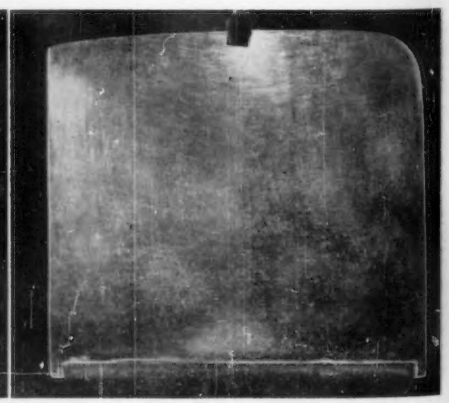


Fig. 16.—Plexiglas After Service for One Year in a 1941 Buick Sedan.

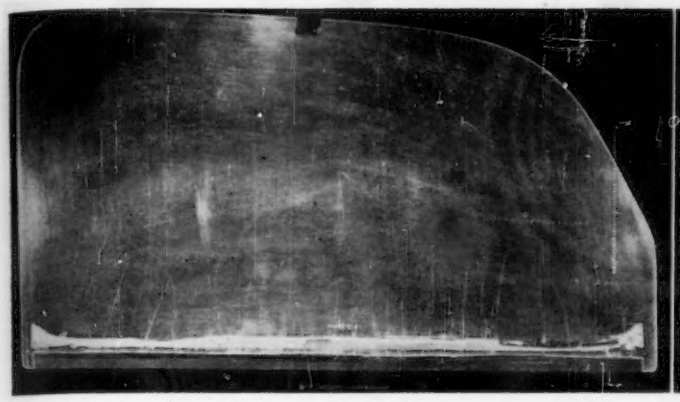


Fig. 17.—CR-39 After Service for One Year in a 1941 Buick Sedan.

Fig. 18.—Lucite After Service for One Year in a 1941 Buick Sedan.

and Figs. 20, 21, and 22, rear ventilator lights, illustrate the relative surface destruction of the three plastics tested after one year of service as body light glazings, and show, as mentioned above, the CR-39 plastic to have a greater resistance to surface abrasion than the methacrylate plastics (Lucite and Plexiglas).

Summarizing, with regard to plastic body light glazings, it may be stated that none of the scratches in these plastics were so annoying that an impartial observer would feel the replacement of the plastic was imperative at the end of one year of service.

General Comments and Conclusions on Plastic Glazings

1. Plastic glazings are extremely difficult to clean, because the road scum does not wash off as readily as from glass surfaces. Further, during wiping to dryness, annoying static developed on the plastic surfaces picking up dust. This fact was commented upon by gasoline station operators. In a new car showroom, it would be extremely difficult, if not impossible, to obtain the luster that characterizes glass glazings.

2. Water did not wet the plastic windshields to the same extent as it did glass, tending to stand up in droplets which the windshield wiper did not readily remove. In body lights, vision was also markedly hampered by these water droplets which do not run off as they do from glass glazings. This was observed to a greater extent with Plexiglas and Lucite than with CR-39, which seems to be wet by water more readily. In general, it was observed that the CR-39 glazings cleaned more readily during service.

3. As the surface of the windshield deteriorated due to the rubbing action of the windshield wiper, it was almost impossible to drive into the sun or bright headlights at night. Further, a very annoying halo and streamer effect was observed when viewing street lights, illuminated window signs, etc., through the abraded area.

4. Due to the low thermal conductivity of the plastic windshield glazing, the heater did not melt the ice and snow as rapidly as in the case of laminated glass. In the case of car B, where the plastic windshield was used throughout the winter, it was only found possible to remove sleet and ice by pouring hot water over the windshield, since it could not be rubbed with any type of scraper without materially damaging the surface. The same statement applies with equal force to the plastic body lights.

5. There is a greater tendency on the part of the plastic glazings to rattle. This is especially true when a doorlight is partially lowered. Undoubtedly rattling occurs due to the fact that the greater resiliency of the plastic gives a whipping action either when the car is in motion or during closing of the car doors.

6. Plexiglas, Lucite, and CR-39 are considerably more resistant to impact than ordinary sheet or plate glass and to that extent are safer when used for automobile glazings. When ruptured, however, sharp, dagger-like particles, similar to ordinary glass, are produced.

7. *¼-In. CR-39* satisfactorily *passes* the following Code test requirements for laminated safety glass: Uviarc Discoloration Test, Humidity Test, Boil Test (with reservations, because it underwent warpage), Visibility Distortion Test, and ½-lb. Steel Ball—16-ft. Drop Test.

8. *¼-In. CR-39* satisfactorily *passes* the following Code test requirements

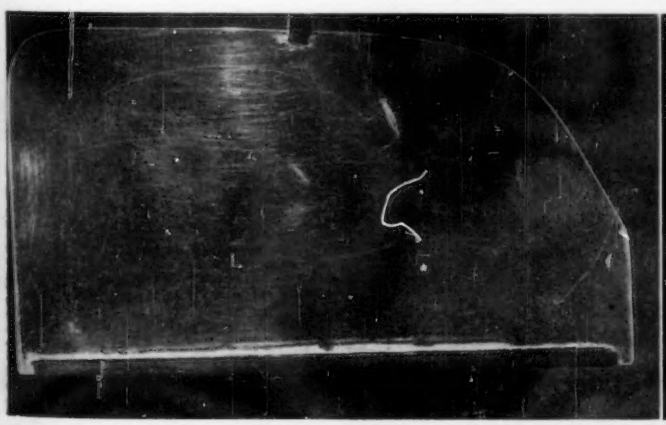


Fig. 19.—Plexiglas After Service for One Year in a 1941 Buick Sedan.

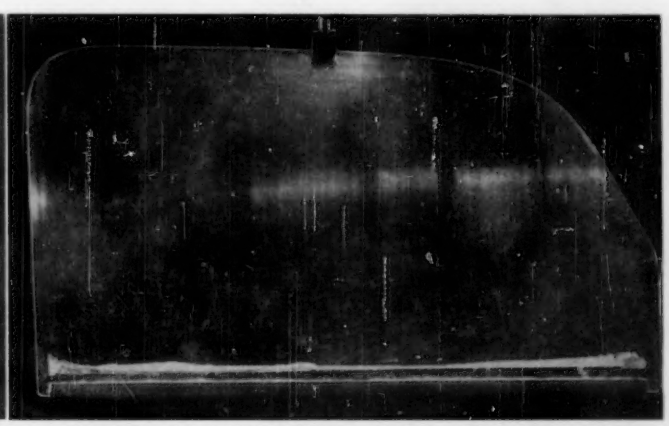


Fig. 20.—CR-39 After Service for One Year in a 1941 Buick Sedan.

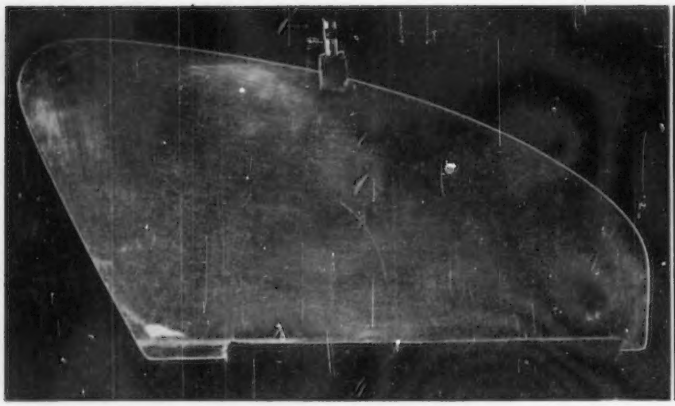


Fig. 21.—Lucite After Service for One Year in a 1941 Buick Sedan.

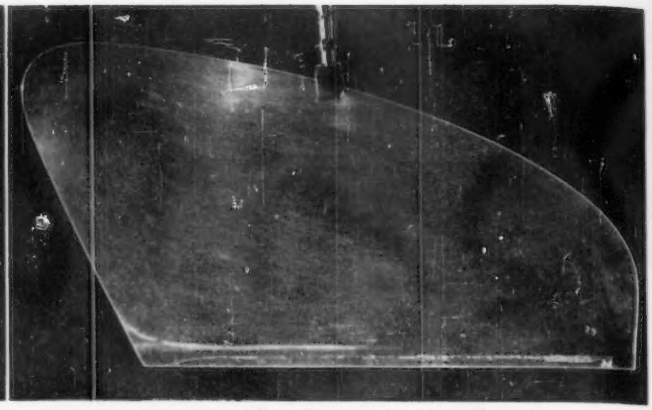


Fig. 22.—Plexiglas After Service for One Year in a 1941 Buick Sedan.

for heat-strengthened glass: ½ lb. Steel Ball—10-ft. Drop Test.

But *fails to pass* the 11-lb. shot Bag—8 ft. Drop Test.

9. ¼-*In. Lucite* satisfactorily *passes* the following Code test requirements for laminated safety glass: Humidity Test, Boil Test (with reservation, because it underwent warpage), Visibility Distortion Test, ½-lb. Steel Ball—16-ft. Drop Test, and the 7-oz. Steel Dart—10-ft. Drop Test.

But *fails to pass* the Uviarc Discoloration Test.

10. ¼-*In. Lucite* satisfactorily *passes* the following Code test requirements for heat-strengthened glass: ½-lb. Steel Ball—10-ft. Drop Test and 11-lb. Shot Bag—8 ft. Drop Test.

11. ¼-*In. Plexiglas* satisfactorily *passes* the following Code test requirements for laminated safety glass: Humidity Test, Boil Test (with reservations, because it underwent warpage), ½-lb. Steel Ball—16-ft. Drop Test and the 7-oz. Steel Dart—10-ft. Drop Test.

But *fails to pass* the Uviarc Discoloration Test.

12. ¼-*In. Plexiglas* satisfactorily *passes* the following Code test requirements for heat-strengthened glass: ½-lb. Steel Ball—10-ft. Drop Test and 11-lb. Shot Bag—8 ft. Drop Test.

13. Plexiglas and Lucite are equally as stable to sunlight as CR-39 in spite of the fact that CR-39 passed the Code test, while Plexiglas and Lucite failed. In other words, while CR-39 is stable to the extremely intense radiation of the Uviarc called for in the Code Discoloration Test, all three plastics are of comparable stability when exposed to a less intense source of radiation.

14. Glass materially excels CR-39, Plexiglas, and Lucite from the standpoint of scratch resistance, since polishing and cleaning agents used on glass, such as rouge and Bon Ami, instantly scratch all three plastics.

15. The life of Plexiglas or Lucite in the windshield under average conditions using the wiper occasionally ranges from 30 to 45 days. Beyond the 30-day period, driving with the abraded windshield is dangerous, inasmuch as it was difficult in making turns to ascertain the location of the curb or whether or not a pedestrian was standing on the curb or in the highway.

16. The life of CR-39 windshields subjected to occasional windshield wiper action is at best not more than 60 to 180 days.

17. Safety plate glass windshields, from the standpoint of vision, are far superior after three to four years' service to CR-39, Plexiglas, and Lucite after a few weeks' service.

18. Careful comparison of Fig. 10 with Fig. 8 shows that during three to four years' service in an automobile, safety plate glass windshields suffer a slight amount of scratching which, however, is not visible looking directly through the windshield.

19. All CR-39, Plexiglas, and Lucite body lights, after 12 months of service, show numerous scratches varying from hair line to deep scratches. These scratches were not so annoying at the end of one year's service that an impartial observer would feel their replacement was imperative.

20. Plastic glazings do not present a serious fire hazard, but certainly afford less protection than glass glazings from this standpoint.

21. Plastic glazings on rupture, either from sources within or without an automobile, leave sharp, cutting edges that are as hazardous as ordinary plate or sheet glass. In this respect, CR-39 is worse than Plexiglas or Lucite, since for any given impact more fragments are formed. (Compare Fig. 2 with Fig. 1).

Measurement of Transparency of Surface Coatings[1]

By J. Gross,[2] R. H. Kienle,[2] L. A. Melsheimer,[2] and E. I. Stearns[2]

SYNOPSIS

Transparency is the property of a specimen in which the transmitted light tends to continue in a direct beam and not be scattered. It may be measured photometrically and objectively defined as the ratio of the directly transmitted light to the total transmitted light. It is not influenced by color, but it is influenced by the presence of light scattering particles, and by film thickness if the transparency is not perfect.

IN CERTAIN applications it is desired to have protective and decorative coatings transparent. One example of this is the coloring of Christmas tree ornaments where the colored film is placed over a highly reflecting metallic or silvered glass surface. The purpose of the film in this case is not to obscure the metal surface at all but rather to color the highlights which are reflected from it. Another application of transparent film is in printing inks or coatings to be applied to cellophane, glass, or some other transparent material where the object is to impart color without obscuring the view. Examples of this are to be found in wrappers for candy and other merchandise. Such transparent coatings are important in the finishing of tin plate, metal foil, and metal jewelry.

Thus, it is apparent that a method of measurement of transparency of surface coatings is of considerable importance to both the manufacturer and user of decorative finishes.

Practical Evaluation:

In the case of a film applied over a reflecting surface such as a metal, transparency is evaluated by looking at the sample and noting how clearly a reflection is imaged. In the case of the film over clear glass or other transparent support, the specimen is viewed by transmitted light to observe clarity or haziness of the film. There is a similarity in these two cases; in both, the main interest is to have the light pass directly through the pigmented film without any distortion or scattering.

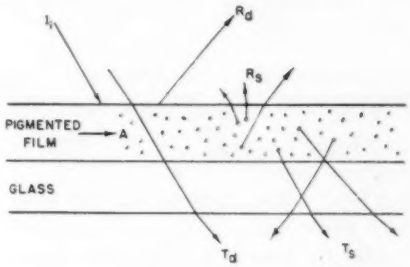


Fig. 1.—Transparent Film Over Glass.

Theoretical Considerations:

A reference to Figs. 1 and 2 may clarify what is meant by transparency and show how light scattering is the optical phenomenon that impairs transparency. Figure 1 shows what happens to light when it attempts to pass directly through a film containing pigment particles capable of scattering light, placed on top of glass. In this figure, I_i represents the incident light. Because of the differences in refractive index between the air, the pigmented film, and the glass, a certain amount of light is directly reflected back at each interface. All three of these quantities of light combine to comprise the directly reflected beam indicated by R_d of the figure. Some of the light passes through in straight lines, not scattered in any way, and this portion is indicated by T_d. Some light strikes the pigment particles in the pigmented film and is scattered by them in a backward direction. This light returns to the air through the film-air interface, but is given off in all directions. This portion of light that is scattered in a backward direction is indicated by the symbol R_s. Some of the light that is scattered by the pigment continues in a forward direction but not in an undeviated line, and this light comes off in all directions through the glass-air interface. This is the scattered, transmitted light and it is designated by T_s on the figure. All the light, while passing through the film, regardless of whether it is directly transmitted or scattered, and regardless of the direction in which it finally leaves the film, is subject to absorption by the pigmented film and the glass. This absorbed light is converted to heat and is not visible. This fraction is represented by A in the diagram. It is possible to write an equation based on the law of conservation of energy involving these different energies, and it is found that:

$$I_i = R_d + R_s + A + T_d + T_s$$

Figure 2 shows the schematic situation when a similar pigmented film is placed over metal. Here again I_i is the intensity of the light incident on the film. Some of this is directly reflected from the first surface, and this is designated as R_d or directly reflected light. Some of it penetrates through the film, is reflected from the metal, and comes out into the air. The path of this light is a line that is bent in only three places and such that its angle when leaving the film is equal to the angle at which the light struck the film. This is obvious when the places of bending are noted. The light path is bent at the air-film interface, at the metal, and at the film-air interface. The bending at

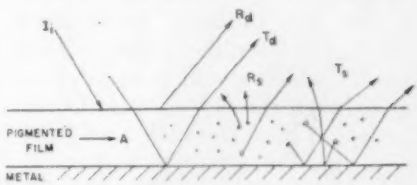


Fig. 2.—Transparent Film Over Metal.

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[1] Presented at a meeting of A.S.T.M. Committee D-1 on Paint, Varnish, Lacquer, and Related Products held in Washington, D. C., March 3, 1948.

[2] Research and Technical Service Departments, Calco Chemical Division, American Cyanamid Co., Bound Brook, N. J.

the film-air interface is exactly equal and opposite to the bending at the air-film interface. The reflection at the metal takes place in such a manner that the angle of reflection is equal to the angle of incidence. This light has been designated as T_d for it corresponds to the directly transmitted light in Fig. 1, although, of course it has been reflected by the metal. In addition to these, some light is scattered by the pigment particles and never reaches the metal but is returned to the air in a random direction. This part of the light is represented as R_s, or the diffusely reflected light. Some of the light that is scattered by the pigment particles, instead of coming directly out into the air, strikes the metal first and is reflected from it and finally finds its way out. This reflected, scattered light has been designated as T_s and indicates the part of the scattered light that is reflected from the metal. It will be noted that this light, were it not for the metal, would come out through the lower film interface and would correspond to T_s in Fig. 1. In addition to this, all the light while passing through the film is subject to some absorption. Here again the part of the energy which is lost by absorption is indicated by A.

This film over metal is very much like the film over glass, but since the light must pass down through it, be reflected from the metal, and come back again, the film is effectively a double thickness.

Figure 2 differs from Figure 1 only in that the diffusely transmitted light T_s and the directly transmitted light T_d which would tend to come out through the bottom part of the pigmented film, were the metal not there, are reversed in direction. With this qualification, Figs. 1 and 2 are seen to be very similar in the action of the pigmented film on light.

Practical Definition of Transparency:

Considering these two figures, it then becomes easier to define what is meant by transparency. In the case of the glass with the pigmented film on it, the specimen is transparent if the light comes directly through without any scattering; that is, if the ratio of the amount of light represented by T_d to the amount of light represented by $T_s + T_d$ is one. In the case of the pigmented film over metal, again a high ratio of the light passing through a film without scattering, here $T_d + R_d$, to the total amount of light passing through, $R_s + T_s + T_d + R_d$, indicates good transparency. As a practical definition, therefore, it may be said that *a pigmented film has a high transparency if it has the characteristic that visual radiant energy may pass through it in a direct beam without scattering.* It may be noted that the light reflected from the surface, R_d, may be either specular or diffuse, depending upon the roughness of the surface, but this enters into a measure of the gloss of the film and is outside the scope of this paper which deals solely with transparency within the film.

Measurements of Light Energies:

With a General Electric type spectrophotometer it is quite easy to evaluate separately R_d, R_s, T_d, T_s, and A of a specimen of the test film over clear glass. These measurements are made as follows: R_s is measured by placing the pigment specimen at the reflectance window and using the black porthole. The sum of R_s and R_d is measured by placing the sample at the reflectance window and using a white porthole. Subtracting the former value from the latter value gives R_d. By placing the sample in the transmission chamber adjacent to the integrating sphere, $T_s + T_d$ is measured. By placing the sample in the transmission chamber as far from the entrance window of the integrating sphere as possible, T_d is measured. The difference between this value and the previous value is T_s. The sum of these four values, namely, R_d, R_s, T_s, T_d, when subtracted from 1 gives the value of A.

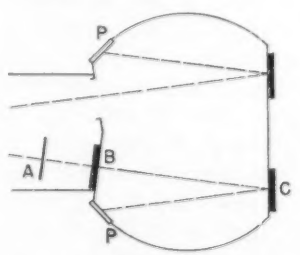

Fig. 3.—Schematic Diagram of the Integrating Sphere of the GE Spectrophotometer.

A is the position for the measurement of T_d; B for $T_s + T_d$; C for $R_s + R_d$. P is the porthole, using black and white portholes, respectively.

Transparency, from the viewpoint of the physicist, might take either of two definitions, depending upon the method of test. If the transparency of a film on a glass support is to be measured, the mathematical formula which would define transparency is indicated by:

$$\text{Transparency} = \frac{T_d}{T_d + T_s} \quad \ldots\ldots(1)$$

On the other hand, if the transparency of a film over a mirror were to be evaluated, the equation would be:

$$\text{Transparency} = \frac{R_d + T_d}{R_d + T_d + R_s + T_s} \quad \ldots(2)$$

In the practical concept, although there may be a slight difference in the evaluation by these two methods, they should agree fairly well, and it should be possible to use either evaluation. It is interesting, therefore, to compare the two possible definitions of the physicist to see if these give approximately the same results.

To test out these two equations, four samples were prepared: one a highly transparent yellow, one a highly transparent red, one a moderately transparent yellow, and one a poorly transparent yellow. By visual observation the yellows differed in transparency as the adjectives indicate, and the red appeared to be equally as transparent as the good transparent yellow. It was generally conceded that less light came through the red sample than through the yellow sample, but it was just as easy to read print through a glass sample of one as the other, and just as easy to discern reflected images from a mirror coated with one as the other. The five values defined above were evaluated with a General Electric spectrophotometer for each of these four samples with the results shown Table I.

It will be noted that, as had been expected, the two equations gave calculated transparency values which were closely alike. The transparent yellow and red were about alike and the three samples of yellow were arranged in the same order and given roughly the same magnitude

TABLE I.—TRANSPARENCY CALCULATION DATA.

	R_d	R_s	T_d	T_s	A	Transparency 1	Transparency 2
Highly transparent yellow	0.065	0.020	0.603	0.063	0.249	0.91	0.89
Highly transparent red	0.037	0.010	0.070	0.006	0.877	0.92	0.87
Moderately transparent yellow	0.065	0.035	0.605	0.122	0.173	0.83	0.81
Poorly transparent yellow	0.054	0.045	0.397	0.168	0.338	0.70	0.68

$$\text{Transparency 1} = \frac{T_d}{T_d + T_s} \qquad \text{Transparency 2} = \frac{R_d + T_d}{R_d + T_d + R_s + T_s}$$

of transparency by both equations. Therefore, there seems to be little to choose between these two equations as far as the evaluation of a physical concept is concerned. However, there may be some choice of methods so far as ease of measurement is concerned.

Similar Test Methods:

There is available an A.S.T.M. Method of Test (D 672–45 T) for evaluating directly transmitted light and total transmitted light.[2] It was developed for evaluating the amount of light scattered by a supposedly transparent plastic. The haze of the sample is defined as $T_s/(T_d + T_s)$. It will be noted that the first definition of transparency given above plus this definition of haze equals 1, so that one is the opposite of the other. Thus if a sample has a haze of 0, it has a transparency of 1, and if it has a haze of 1, it has a transparency of 0. Accordingly, if definition No. 1, is adopted there is a suitable A.S.T.M. instrument for evaluating transparency.

This measurement, $T_d/(T_d + T_s)$, is the one which has been used in the evaluation of the samples described in the remainder of the paper. However, instead of measuring it with the exact device designated in this A.S.T.M. method, the value was obtained with a General Electric spectrophotometer. This was done by making two measurements. The first measurement in the spectrophotometer was made with the transparent glass sample adjacent to the integrating sphere, in which case the total amount of light transmitted was measured, that is, $T_d + T_s$. The sample was then moved $7\frac{1}{2}$ cm. away from the entrance window, and the directly transmitted beam was measured. The ratio of these two measurements is the transparency according to definition No. 1. In the case of A.S.T.M. Method D 672–45 T, the portion of the scattered light included in the direct transmission measurement is calculated to be only 0.075 per cent, while in the case of the spectrophotometric measurement, the portion of the scattered light included in the direct transmission is 1 per cent. Both of these fractions are so small that a good measurement is obtained by either method. Thus, in the values given above in Table I, the measured T_s in the case of the good transparent yellow was 0.063. When a correction is made for this erroneously included 1 per cent of scattered light, the value is 0.0636 and the value of T_d which was given as 0.603 should have been 0.6024. This correction is so small in the range of samples of interest in evaluation of transparency that it may be considered that the A.S.T.M. test instrument and the spectrophotometer give comparable results.

The A.S.T.M. test for haze specifies that the photocell shall have a spectral response which approximates that of the average human eye. It also says that the tungsten lamp shall operate at its regular voltage, but this does not specify the exact color of the light as different wattage tungsten lamps have different color temperatures. In the interpretation of the spectrophotometric curve, it is also necessary to include a consideration of the color of the light and the response of the eye. This is done by calculating the luminosity for daylight for the curve obtained from each of the two positions. The method of computation of luminosity from a spectrophotometric curve has been completely described.[3] In the method of computation, known as the "selected ordinate" method, the transmittances of the specimen, at specified wave lengths, are read from the spectrophotometric curve and summed. The summation in the "direct only" position (T_d) is divided by the summation in the "total" position ($T_d + T_s$). The A.S.T.M. test for haze has the advantage that the photocell automatically carries out the summations.

In the case of several samples, calculations from the spectrophotometric curve were made for both daylight and tungsten light, and with both illuminations the transparency results obtained were essentially identical. Thus, the color temperature of the light used is not critical. If it were, a standard light source could easily be specified.

It may be noted that the A.S.T.M. test D 672–45T does not recommend this method of measurement for low ranges of haze, that is, ranges less than 3 per cent. On the other hand, many commercial samples of interest fall in the transparency range of 97 per cent or more, and therefore it may be wondered why this method of test is recommended here for a condition which is not recommended in the method for haze of plastics. No difficulty was found in evaluating transparency in this range, provided the sample has a smooth surface. In the case of a sample which has a poor surface, the light is deviated as it enters the film in the same way that the light is deviated by a prism or a lens, and this deviated light appears as scattered light in the measurement. Also, a remeasurement of this type of specimen on different areas may give different values depending upon the particular spot through which the light beam passes. The deviations arising from the surface irregularity will amount to a major part of the scattered light in the case of the highly transparent samples. However, by carefully preparing the test specimens making sure that they had smooth surfaces, and that the glass on which they were prepared was not wavy, good results were obtained even, in this range of high transparency.

The measurement of transparency according to the second definition given above is very much like the measurement of contrast gloss. Measurements of contrast gloss include measurements of the directly reflected light and also of the diffusely reflected light. However, there are no A.S.T.M. methods of evaluating contrast gloss, and, as is

[2] Tentative Method of Test for Haze of Transparent Plastics by Photoelectric Cell (D 672–45 T) (1946 Book of A.S.T.M. Standards, Part III-B, p. 870.

[3] A. C. Hardy, "Handbook of Colorimetry," Technology Press (1936).

evident from the data of Table I, this second definition of transparency has no particular advantage over the first. Therefore, it was not used to evaluate the samples.

Effect of Color on Transparency Measurements:

Samples were prepared by dispersing selected pigments in an alkyd-modified nitrocellulose lacquer and casting films of 2 mils dry film thickness on plate glass slides. This was done for six different colors at a pigment concentration of 5 per cent. Pigments producing finishes of good transparency were chosen. The results are listed in Table II.

TABLE II.—EFFECT OF COLOR.

	Transparency	$T_d + T_s$
Yellow	0.84	0.88
Orange	0.91	0.42
Red	0.92	0.08
Violet	0.95	0.06
Blue	0.99	0.33
Green	0.93	0.25

It will be noted that the total amount of light transmitted by these six samples is quite different. The yellow transmitted 88 per cent of the light while the green transmitted only 25 per cent of the light. Thus, in general, objects looked darker when viewed through the green sample than when viewed through the yellow sample. However, in this concept of transparency, it is not the total amount of light transmitted by a sample which is important, but it is the geometrical behavior of this light as it passes through the film that is important. In the case of all six samples, the light which did pass through and which was not absorbed passed through almost completely in a direct line and, therefore, all six samples had high transparency values. Thus, color has no effect on measurements of transparency as herein described.

Effect of Film Thickness on Transparency Measurements:

Table III shows the effect of film thickness. Four lacquer coatings were prepared using two hydrated ferric oxides that were identical in chemical composition but widely different in particle size. One sample of hydrated ferric oxide had a very small particle size and by itself, in the coating, was quite transparent while another sample had a large particle size and was quite

TABLE III.—EFFECT OF THICKNESS.

Film Pigmentation	Transparency, per cent	
	0.001 in.	0.002 in.
Unpigmented	1.00	1.00
100 per cent transparent pigment	0.98	0.97
99 per cent transparent pigment + 1.0 per cent opaque pigment	0.95	0.91
97.5 per cent transparent pigment + 2.5 per cent opaque pigment	0.90	0.79

opaque. These two samples of hydrated ferric oxide were used as required to get coatings of varying transparency indicated as unpigmented, 100 per cent transparent pigment, 99 per cent transparent pigment + 1.0 per cent opaque pigment, and 97.5 per cent transparent pigment + 2.5 per cent opaque pigment. The pigmented lacquers contained 5 per cent of pigment, by weight. Each of these four lacquers was put on a piece of glass so that the dry film thickness was approximately 0.001 and 0.002 in. The transparency values are listed in Table III. It will be noted that in the case of a highly transparent film the thickness is not very important, while in the case of a poorly transparent film the thickness is quite important.

It will be noted that transparency is a property of a specimen film and not a property of a pigment. While many pigments may be referred to as "transparent" or "opaque," these descriptive terms are based on the properties they exhibit in coating compositions in the manner in which they are normally used. As in the case of opacity or hiding power measurements, transparency measurements are made only on surface coating films. Thus, a particular pigment designated as 97.5 per cent transparent pigment + $2\frac{1}{2}$ per cent opaque pigment in Table III had a transparency of 0.90 per cent or 0.79 per cent, depending upon the specimen into which it was prepared. Therefore, it is not possible to assign any transparency value to a pigment. However, it may be said that specified pigments, if properly prepared, will give specimens which have high transparencies and the transparencies of such specimens may be evaluated.

Physical Definition of Transparency:

In view of the above discussion it seems proper to suggest that transparency may be measured objectively and may be defined as:

$$\text{Transparency} = \frac{T_d}{T_d + T_s}$$

where:

T_d = directly transmitted light, and
T_s = diffusely transmitted light.

The specimen, if not self-supporting, should be mounted on a highly transparent material such as glass. The light may be specified as standard daylight (illuminant C as defined by the International Commission on Illumination[4]). The response of the receptor may be defined as the luminosity function of the standard observer (the tristimulus function Y as defined by the International Commission on Illumination). The limit of acceptance of T_s of the photometric apparatus assuming a completely diffuse T_s may be specified as 1 per cent or less.

To evaluate pigments for their relative ability to produce specimens of high transparency, it is necessary to specify all the details of formulation. The effect of dry film thickness is especially important.

Summary

Because of the increasing demand for light fastness and durability of transparent coatings, it is believed that there will be an increasing tendency to use pigments rather than dyes as colorants. Pigments may contribute undesirable scattering in such films, and accordingly it is desirable to have a recognized definition of transparency and an objective method of test to evaluate this property. It is suggested that a descriptive definition of transparency be given as "that characteristic of a specimen that causes the portion of light which is transmitted to pass through in a direct beam without scattering." It is suggested that an objective method of test such as A.S.T.M. Method D 672–45T or an equivalent spectrophotometric procedure be used. The quantitative definition of transparency is, then, the ratio of directly transmitted light to total transmitted light. Data are given to show the effect of color, film thickness, and type of pigment upon transparency.

[4] D. B. Judd, *Journal of the Optical Society of America*, Vol. 23, p. 194, pp. 359–374 (1933).

A Method for the Routine Determination of Dry Hiding Power of White Paints[1]

By F. C. Schmutz[2] and J. M. Gallagher[2]

HIDING power appears to be covered by published methods of test more than any other property of pigmented finishes. These methods range from the very practical type of test, as a brushout over large areas with evaluation of the result by visual observations, to the highly controlled laboratory tests with mechanical application of the test material and photometric measurement of the result. The brushout tests and comparative drawdown methods, which rely on visual gradings, are fairly rapid but lack accuracy and reproducibility. On the other hand, the laboratory tests, as, for example, the "spinning disk" method (1),[3] are comparatively accurate and reproducible, but slow, and do not lend themselves to routine work of any great volume. These comments apply essentially to the determination of dry hiding power. Wet hiding can be determined rapidly and accurately through the use of the Pfund cryptometer and modifications utilizing the photoelectric measuring devices. Technical men agree that wet and dry hiding are not comparable, and, since the value of pigmented coatings is realized only in the dry state, the major interest must be in dry hiding.

As previously indicated, the present methods do not combine speed and accuracy well enough to function as control tests where a large number of routine determinations are required. In the absence of a suitable hiding power method, tinting strength has been used as a control test in the production of pigments and as a guide in development work. However, since no reliable relationship has been established between hiding and tinting strength, the latter cannot be generally accepted as a measure of hiding. The hiding power method discussed in this paper has been used in our laboratory as a routine control, and results have been sufficiently encouraging to warrant the publication of the procedure, in the hope that it will stimulate interest among other workers who might find it useful and make improvements in the method.

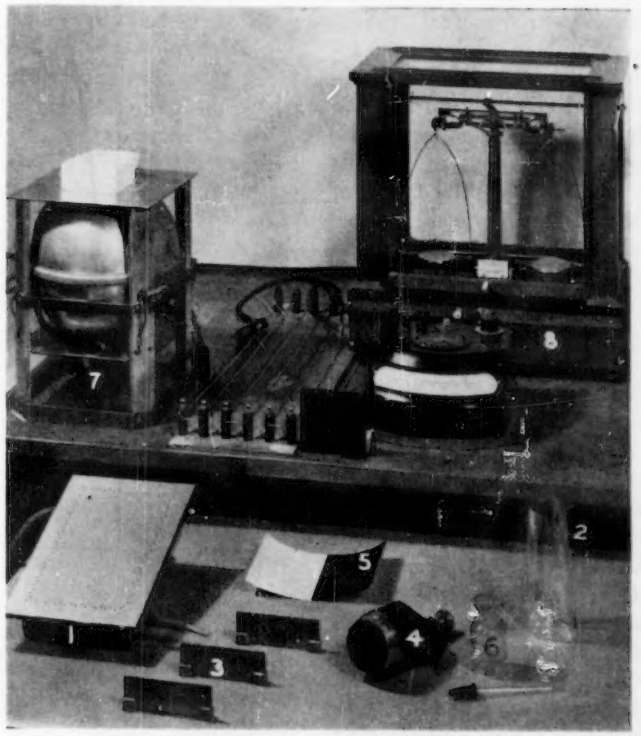

Fig. 1.—Equipment for the Hiding Power Test.

EQUIPMENT

The required material is illustrated in Fig. 1 and is described below in further detail. There are many modifications of the equipment which can be used.

1. *Suction Box.*—This is a metal box approximately 10 by 6½ by 2 in. with one of the large faces, an accurately machined, stainless steel, plane surface. A random pattern of suction holes is drilled around the outer edge. The box is connected to a source of vacuum.

2. *Cellophane.* — The "plain" colorless untreated material (du Pont No. 450), 0.0011 in. thick, is used. The "treated" product affects the drying of paints.

3. *Film Applicators.*—Any type of applicator or doctor blade may be used which will make uniform films between 1.5 and 3 mils in thickness and at least 3 in. in width.

4. *Die Cutter.*—A tool is required which will accurately cut a predetermined area of the cellophane. A circular die 2¼ in. in diameter has proved very satisfactory, but the size of the die required will depend upon the dimensions of the reflectometer being used.

5. *Black-and-White Contrast Backgrounds.*—In harmony with published work, surfaces with black and white areas having reflectances of 0 (0.05 or less) and 0.80 ± 0.01 have been set up as standard. A very satisfactory background has been prepared from Eastman double weight paper, Azo F2, by exposing

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[1] Presented at a meeting of A.S.T.M. Committee D-1 on Paint, Varnish, Lacquer and Related Products held March 3, in Washington, D. C.

[2] Technical Department, The New Jersey Zinc Co. (of Pa.), Palmerton, Pa.

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

one-half of a $4\frac{1}{4}$ in. square and developing the whole sheet.

6. *Dibutyl Phthalate (Refractive Index, 1.49).*—Any colorless inert liquid of low volatility and with an index of refraction in this range will suffice. Tricresyl phosphate (refractive index, 1.55) has also worked well.

7. *Reflectometer.* — The reflectometer used in this work is an integrating sphere type with a photovoltaic cell and green liquid filter to adjust the spectral response of the cell to approximate that of the human eye. Other accepted types of reflectometers may be used.

8. *Analytical Balance.* — The laboratory type sensitive to 0.1 mg. under full load is required.

Procedure

Cellophane is spread on the machined face of the suction box until it is held as a firm, smooth, taut film by the vacuum. The test paint is applied to the cellophane with the spreader so as to obtain a uniform film about 3 by 6 in. The cellophane is then stripped from the box and set aside to allow the paint to dry. After drying, disks are cut with the die and accurately weighed. A thin coating of dibutyl phthalate is next applied to the cellophane side of the disk. The disk is pressed, painted side out, to the white background and its brightness determined with the reflectometer. Brightness measurements are then made on the *same* disk, after transferring it to the black background. The ratio of the reading over black to the reading over white is the contrast ratio for the particular paint thickness.

A few disks of clear cellophane are cut with the die and are weighed to establish a representative figure for the tare weight. This tare is subtracted from the weight of the painted disk to arrive at the weight of the dry paint film. If the hiding is based upon wet paint formulation, it will then also be necessary to establish the change in weight for the test paint upon drying. There are a number of methods given in the literature for determining such values (2).

Discussion of the Procedure

Commercial cellophane of the indicated thickness has been found to be relatively uniform. In addition, the day by day change in weight due to moisture absorption by the untreated cellophane has not proved to be a factor. Table I indicates the variation in tare weights of cellophane blanks cut daily for ten consecutive days.

TABLE I.—TARE WEIGHTS OF CELLOPHANE BLANKS, g.

0.1065	0.1089
0.1078	0.1092
0.1092	0.1073
0.1090	0.1086
0.1097	0.1079

Average value, 0.1083 g.
Greatest difference, 0.0032 g.

Hiding procedures similar to the one discussed in this paper but using the black-and-white hiding power sheet of paper instead of cellophane are referred to in the literature (3). These paper backgrounds are nonuniform in thickness and vary greatly in weight from sheet to sheet. Fourteen $2\frac{1}{4}$-in. disks cut at random from the white and the black portions of the same paper showed the following range in weights:

White—0.7797-g. maximum
0.7650-g. minimum
difference, 0.0147 g.

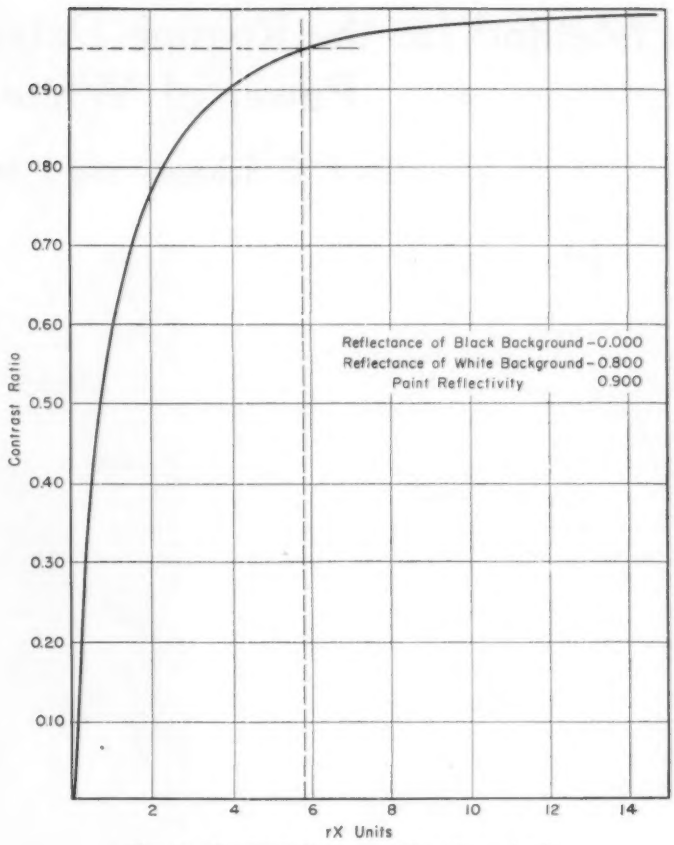

Fig. 2.—Contrast Ratio as a Function of *rX*.

Black—0.7959-g. maximum
0.7742-g. minimum
difference, 0.0217 g.

If a 0.004-in. spreader is used, the weight of dry paint on a $2\frac{1}{4}$-in. disk is commonly of the order of 0.1500 g. Since the variation in weight in the case of paper hiding sheets is about 0.015 g. and for cellophane about 0.003 g., the error introduced by nonuniformity is much less for cellophane than for paper, the greatest error introduced by the cellophane due to nonuniformity being approximately 0.0032/0.1500 or 2 per cent.

TABLE II.—REFLECTANCE THROUGH CELLOPHANE.

	White Background	Black Background
Background only	0.808	0.018
With cellophane and air interface	0.779	0.072
With cellophane and water interface	0.789	0.022
With cellophane and dibutyl phthalate interface	0.801	0.017
With cellophane and tricresyl phosphate interface	0.801	0.017

The use of a liquid of high refractive index between the cellophane and the background minimizes the loss of light at this interface. The data in Table II show the importance of considering this loss.

There may be some question whether the liquids in the table are the best for the purpose because of the light-absorption characteristics of the liquids themselves, but no work has been done to establish this point. In the ideal case, the refractive indices of the test paint vehicle, cellophane, and liquid should be equal.

Mathematical Development of the Data

Hiding power can be developed from contrast ratio data in the usual manner. By laying down different thicknesses of the same paint on cellophane, it is possible to obtain a range in contrast ratios. From such data a plot can be constructed to show the relationship of paint weight per unit area to contrast ratio. The weight of paint required to achieve a specific contrast ratio can then be determined and calculated as hiding power in any convenient units. The relationship is:

$$\text{Hiding Power} = \frac{A}{W \cdot R \cdot P} \quad \ldots\ldots (1)$$

where:

A = area of test film,
W = weight of dry paint on A required to attain the specified contrast ratio,
R = ratio of weight of paint in A when wet compared to its weight when dry, and
P = per cent pigment in wet paint.

For any given system, A, R, and P are constants. Therefore,

$$\text{Hiding Power} = K/W \quad \ldots\ldots (2)$$

The work covered by this paper has been carried on so as to give data in terms of square feet per pound of pigment.

Application of the Method to Paints of Identical Composition

Where many samples are involved, the procedure becomes laborious because of the almost prohibitive number of individual contrast determinations required. It was realized that the problem would be greatly simplified if only one determination were required for each sample and if this determination were made at the desired contrast ratio, or close enough to permit accurate extension to the desired contrast ratio. A graphic aid has been devised to facilitate this extrapolation, and through its use it has been possible to determine the hiding of a paint from a single contrast ratio - film weight determination. The use of this aid is restricted to paints falling in a narrow range of reflectivity, or reflectance at infinite thickness, for the form of the contrast ratio curve varies with paint reflectivity. However, in the grading of standard paints containing nearly identical samples of pigment this restriction is not a factor, and in cases where paints of various reflectivities are to be graded additional charts can be constructed.

The graph is based on the concept that the relationship of thickness to the contrast developed by a paint film is fixed by the background reflectances, by the paint reflectivity, and by the optical strength of the paint. With the first two of these fixed, for any one paint only one curve of contrast ratio - weight relationships can apply. For a second paint, another curve may apply, and the determination of hiding is reduced to the problem of establishing which curve applies to the paint in question.

These curves for contrast ratio-weight relationships may be developed from the theoretical expressions for film brightness. Kubelka and Munk (4) have derived equations describing the reflection of light by diffusing media. Judd and others (5) have shown that these equations can be used to predict with reasonable accuracy the reflectance of various thicknesses of vitreous enamels, cold water paints, paper, and dental cements. Steele (6) has applied the equations to reflectance measurements on paper. Our laboratory has found the equations valuable in the study of paints and applicable to the hiding power problem. The equation of Kubelka and Munk is:

$$H = \frac{\frac{1}{H_\infty}(H' - H_\infty) - H_\infty\left(H' - \frac{1}{H_\infty}\right)e^p}{(H' - H_\infty) - \left(H' - \frac{1}{H_\infty}\right)e^p} \quad \ldots\ldots (3)$$

where:

H = the reflectance of the film,
H_∞ = the reflectivity of the paint or reflectance of an infinite thickness of paint,
H' = the reflectance of the background,
$p = rX\left(\frac{1}{H_\infty} - H_\infty\right)$
X = the thickness of the film, and
r = constant of the medium and a measure of its ability to return light by reflection, refraction, and scattering.

If definite values are assigned to H' and H_∞, H becomes a function of rX only. Substituting $H' = 0$ and 0.800 for the backgrounds and $H_\infty = 0.900$ for the reflectivity of a typical paint, the values obtained for film brightness as a function of rX are as shown in Table III. A plot of the rX and contrast ratio values gives the familiar curve in Fig. 2 wherein contrast ratio increases with film thickness rapidly at first and then approaches 1.00 or unity asymptotically. This curve should apply to any paint regardless of formulation, provided its reflectivity is 0.900 and the backgrounds[4] are 0 and 0.800, and the equation of Kubelka and Munk correctly describes the behavior of a film of that paint. Tests have shown that paints of the formula used in our hiding power work do follow the predictions of the equation within the limits of experimental error, at least in the regions above 0.75 reflectance. The correspondence can be shown by the methods used by Judd, wherein for various film thicknesses the film weights and film reflectances over black and over white backgrounds are determined, and the corresponding rX values are computed. If the ratio of rX to film weight is constant over the range of film thicknesses, it is concluded that the equation is applicable. There is no assurance that the performance of all paints

TABLE III.—REFLECTANCE AND CONTRAST RATIO AS A FUNCTION OF rX.
(Calculated from Eq. 3.)

1	2	3	4
rX	H when H′ = 0	H when H′ = 0.80	Contrast Ratio = Col. 2 ÷ Col. 3
1	0.4977	0.8258	0.6027
2	0.6610	0.8435	0.7836
3	0.7408	0.8566	0.8648
4	0.7873	0.8661	0.9089
5	0.8172	0.8735	0.9353
6	0.8375	0.8790	0.9528
7	0.8521	0.8832	0.9647
8	0.8628	0.8867	0.9730
10	0.8770	0.8915	0.9837
12	0.8854	0.8945	0.9898
14	0.8906	0.8964	0.9935
20	0.8975	0.8990	0.9982

[4] For practical purposes, anything less than 0.05 may be accepted as 0.

TABLE IV.—APPLICABILITY OF KUBELKA-MUNK EQUATION.

Paint No. 1 Reflectivity 0.931				Paint No. 2 Reflectivity 0.913			
Contrast Ratio	Film Weight, g.	rX	$\frac{rX}{\text{Film Weight}}$	Contrast Ratio	Film Weight, g.	rX	$\frac{rX}{\text{Film Weight}}$
0.972	0.1863	8.65	46.5	0.963	0.1353	7.12	52.6
0.957	0.1490	6.93	46.6	0.957	0.1259	6.53	51.9
0.943	0.1221	5.77	47.3	0.944	0.1077	5.63	52.4
0.929	0.1072	5.02	46.9	0.923	0.0921	4.83	52.5

will be predicted by the equation, and the agreement should be verified in any doubtful case. Data showing this correspondence for two paints are given in Table IV.

To make practical use of the contrast ratio curve it is necessary to substitute a practical weight (or thickness) scale for the rX scale. According to Eq. 2, W is directly proportional to thickness and consequently to rX in Fig. 2. By matching the rX values with definite values for W, it is possible to develop a family of curves, each of which represents a specific hiding power.

Most of our tests were upon paints having the following characteristics:

Per cent pigment by weight (wet), 25
Wet to dry weight ratio, 1.4
Approximate reflectivity, 0.900

Using a $2\frac{1}{4}$-in. die, the K value in Eq. 2 for this system is 35.83. Then, for a paint of hiding power 200 sq. ft. per pound of pigment, W becomes 35.83/200 or 0.1792 g. as the weight of dry paint. In this work a contrast ratio of 0.95 is used as the end point. According to Fig. 2, the rX value for 0.95 contrast is 5.8. By matching rX at zero and at 5.8 with W values of 0 and 0.1792, the rX scale can be replaced with the more practical W scale, and the hiding curve for the value of 200 sq. ft. per pound becomes the curve of Fig. 2. From this curve it is possible to determine the weight corresponding to any contrast ratio for the paint having the hiding of 200 sq. ft. per pound of pigment. Similarly, curves can be developed for any hiding power to show the contrast ratio - weight relationship. Finally, these curves can all be plotted on the same scale. The results of such a computation are given in part in Table V and fully illustrated in Fig. 3.[5] The family of curves gives the loci of all combinations of contrast ratio and weight corresponding to any given hiding when measurements are made under the conditions of this test work. Conversely, one condition of contrast and weight will designate the hiding.

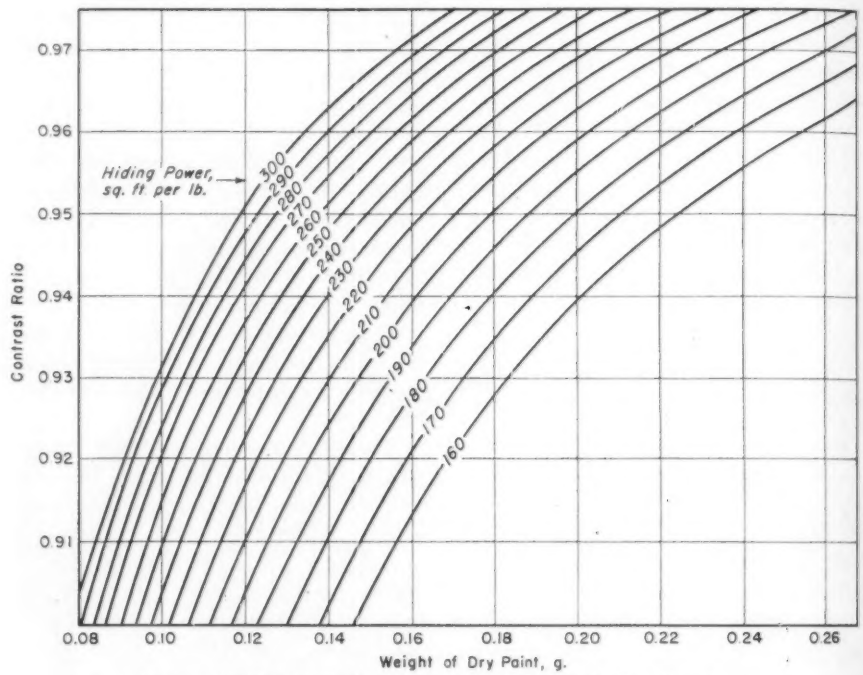

Fig. 3.—Graphic Representation of Hiding Power Relationships.

Discussion of the Graphic Aid

Figure 3 was constructed for use with paints of reflectivity 0.900, since that value was typical of the paints tested. When this chart is used for paints of reflectivity other than 0.900, the indicated hiding power value is exact only if the measured contrast ratio is 0.950. If the contrast ratio is other than 0.950 the chart introduces a small discrepancy between the indicated and the true hiding power. The more the paint reflectivity deviates from 0.900, the more important it becomes to make measurements at 0.950 contrast ratio. However, when the reflectivity falls within a few per cent of 0.900, the actual error in measured hiding power may be disregarded for most practical purposes. As an example, for a paint of reflectivity 0.870 and true hiding power of 200 sq. ft. per lb., Fig. 3 will show an indicated hiding power of 203 sq. ft. per lb., if measurements are made at 0.920 contrast ratio. To minimize this effect of reflectivity on the accuracy of measurement, it is important to control film thickness through selection of spreaders, such that the measured contrast ratio will fall close to 0.950.

TABLE V.—CONTRAST RATIO - WEIGHT RELATIONSHIPS FOR VARIOUS HIDING VALUES.

Contrast Ratio	rX	Weight of Dry Paint Corresponding to Various Hiding Values, g.					
		250	240	230	220	210	200
0.980	9.15	0.226	0.236	0.246	0.257	0.269	0.283
0.970	7.60	0.188	0.195	0.204	0.213	0.223	0.234
0.960	6.60	0.163	0.170	0.177	0.185	0.194	0.204
0.950	5.80	0.143	0.149	0.156	0.163	0.171	0.179
0.940	5.25	0.130	0.135	0.141	0.147	0.154	0.162

[5] Upon development of the family of curves by successive substitutions of weight values in the term rX, each curve is found to correspond to a different value of r. It should not, however, be presumed that r by itself is a measure of hiding power. In the Kubelka-Munk equation defining reflectivity

$$H_\infty = 1 + \frac{s}{r} - \sqrt{\frac{s^2}{r^2} + \frac{2s}{r}} \quad \text{(3a)}$$

where for white substances s is a specific nonselective constant of the medium and is a measure of the ability of the medium to absorb light. Consider one paint film of reflectivity H_1 and constants r_1 and s_1, and a second paint film of reflectivity H_2 and constants $r_2 = r_1$ and $s_2 \neq s_1$. H_2 cannot then be equal to H_1. Since in Eq. 3 reflectance is shown to be dependent on H_∞ as well as on r, it follows that equal thicknesses of the two media cannot exhibit the same reflectance.

Figure 4 illustrates an experiment made specifically to test the contrast ratio chart and incidentally the validity of the application of the Kubelka-Munk equation to this type of coating. Using two paints of different hiding powers, films were spread in various thicknesses so as to develop contrast ratios between 0.90 and 0.96, and the contrast ratio - weight relationships were plotted on a chart developed by the previous procedure. The experimentally determined values are related in the manner predicted by the chart.

The reproducibility of the method is illustrated by the data of Table VI in which are detailed the results

TABLE VI.—REPRODUCIBILITY OF RESULTS.

Test	Hiding Power, sq. ft. per lb.	Deviation from Average, sq. ft. per lb.	Hiding Power Expressed as Per Cent of Average Value
No. 1...	215	3.3	101.6
No. 2...	217	5.3	102.5
No. 3...	214	2.3	101.1
No. 4...	216	4.3	102.0
No. 5...	210	1.7	99.2
No. 6 ..	209	2.7	98.7
No. 7...	210	1.7	99.2
No. 8...	209	2.7	98.7
No. 9...	210	1.7	99.2
No. 10...	208	3.7	98.3
No. 11...	208	3.7	98.3
No. 12...	207	4.7	97.8
No. 13...	212	0.3	100.1
No. 14...	213	1.3	100.6
No. 15...	212	0.3	100.1
No. 16...	217	5.3	102.5

of 16 determinations on a single paint. The maximum and minimum values differ by less than 9 parts in 200.

Conclusion

The hiding procedure discussed in this paper combines simple but precise instrumentation and graphic interpretation of the data into a method which has been very useful in control and research work where a large number of routine determinations are required. The procedure may be varied in many ways to be made applicable to a number of conditions.

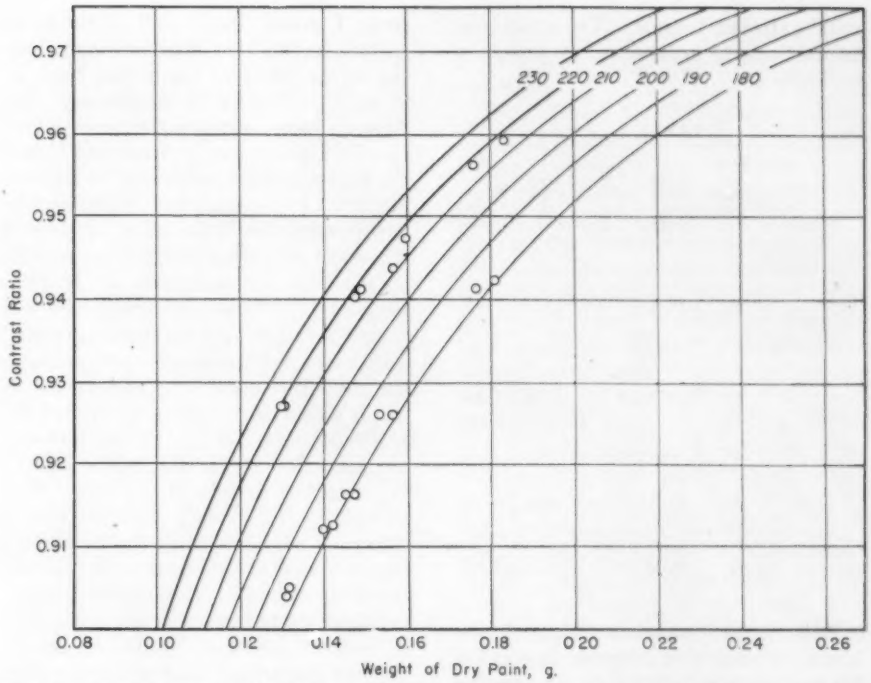

Fig. 4.—Experimental Verification of Graphic Method for Determination of Hiding Power.

Acknowledgment:

We wish to express appreciation to Messrs. D. L. Gamble and C. E. Barnett of The New Jersey Zinc Co. (of Pa.) for their review of the manuscript and extended discussion of the work.

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Discussion of Paper on Magnesium Sulfate Soundness Tests[1]

Mr. F. L. Meara[2] (*by letter*).—The paper by Delmar L. Bloem is very timely in view of the fact that many laboratories have been using the one-day cycle in performing either magnesium sulfate or sodium sulfate tests. Such a cycle provides a drying period of approximately 6½ hr. In November, 1947, the Concrete and Soils Laboratory of the North Atlantic Division of the Corps of Engineers received results of magnesium sulfate soundness tests from two other laboratories on samples of sand which had previously been tested at the North Atlantic Division Laboratory. The losses obtained on the same sand by the three laboratories were approximately 5, 10, and 15 per cent, respectively.

In order to determine the cause of the wide variation in the results obtained by the three laboratories, a cooperative magnesium sulfate test was proposed by the North Atlantic Division Laboratory in December, 1947. The laboratories which participated in the cooperative test were: Concrete Research Division, Waterways Experiment Station, Vicksburg, Mississippi; Ohio River Division Laboratory, Corps of Engineers, Mariemont, Ohio; The National Sand and Gravel Association, Washington, D. C.; and the North Atlantic Division Laboratory, Corps of Engineers, Ithaca, N. Y. Each laboratory was furnished a sample of the sand and requested to run one test in the usual manner, that is, with a drying time of approximately 6½ hr., and to run a second test drying the sample to constant

[1] Delmar L. Bloem, "Effect of Drying Time on Results of Magnesium Sulfate Soundness Tests," ASTM Bulletin, No. 152, May, 1948, p. 76.
[2] Engineer-in-Charge, U. S. Concrete and Soils Laboratory of the North Atlantic Division, Corps of Engineers, Ithaca, N. Y.

weight after each cycle. The results obtained by the four laboratories are given in Table I.

TABLE I.

Name	Time of Drying, hr.	Loss after 5 cycles	Time of Drying, hr.	Loss after 5 cycles	Ratio of Losses
Ohio River Division Laboratory.....	31	16.1	7.0	6.9	2.35
National Sand and Gravel Association Laboratory.....	30.5	12.3	6.5	5.3	2.40
Concrete Research Division, Waterways Experiment Station...	31	14.5	7.25	5.1	2.85
North Atlantic Division Laboratory...	30	16.4	6.0	15.6	1.05

There is good agreement in the losses obtained when the samples were dried for approximately 30½ hr. In the 6½-hr. drying time the losses were less than one-half of those obtained in the longer period except in the result obtained at the North Atlantic Division Laboratory in which the loss after 6 hr. was approximately 95 per cent of the loss obtained after drying for 30 hr. This relatively high loss is probably due to two factors, the use of wire mesh baskets, approximately 3 in. in diameter, and to the use of an oven equipped with a blower and a chimney which keeps the air in rapid circulation and expels the moisture-laden air from the oven. It is believed that the results of this cooperative test substantiate Mr. Bloem's principal conclusion, namely, that to obtain accurate and consistent results from the magnesium sulfate soundness tests the samples must be dried to constant weight.

MR. HERBERT F. KRIEGE[3] (*by letter*). The paper by Mr. Bloem presents some interesting information regarding the effect of drying time on the results of magnesium sulfate soundness test when applied to natural sands. In general, his results confirm earlier work by other investigators showing that prolonged drying causes greater losses than are normally encountered where the testing procedure completes one cycle of immersion and drying in 24 hr. total period. The conclusions which Mr. Bloem draws from his observations, that unless prolonged drying periods are instituted soundness results are not reliable, seem open to serious objections.

In view of the fact that some confusion exists in the minds of testing engineers regarding the variations in conditions when conducting the soundness tests, I would like to call attention to certain factors that might be contributing to the effect of the drying time, as reported. The list of references in Mr. Bloem's paper includes the paper which Leo V. Garrity and I presented before the Highway Research Board in December, 1935.[3] On page 252 of this article, as printed in the *Proceedings*, we showed the effect of protracted drying periods on both natural and stone sands when subjected to immersion cycles in *distilled water* instead of the usual saturated solution of sodium sulfate or magnesium sulfate. We obtained losses with as much variation between the 4 and 48-hr. drying periods as Mr. Bloem did using the saturated magnesium sulfate under the regular conditions of test. This indicates very strongly that the drying period is an added destructive feature beyond the crystallization action we normally expect to be doing the damage.

I have yet to be convinced that drying to actual constant weight is an extremely important matter in our soundness tests. It is probably not generally recognized that the last small losses in weight with prolonged drying are not due to the removal of liquid water from the solution in the aggregate at all, but are quite certainly the water of hydration in the crystal phase or phases present during the conditions in that stage of the drying process. Consider, for example, the use of epsom salts for making the magnesium sulfate solution, the epsom salts being the hepta-hydrate form of magnesium sulfate. According to the chemical literature, such as the quotations made on pages 253 and 254 of the Garrity and Kriege paper,[3] referred to by Mr. Bloem, the full loss of the water of crystallization does not occur until a temperature of 200 C. (392 F.) is reached and maintained for some time. The usual chemical tables show that epsom salt loses up to six molecules of water at 150 C. (300 F.), and the seventh at 200 C. (390 F.). Neither of these temperatures is reached by the oven temperature required for the A.S.T.M. test method, namely, 105 to 110 C. (221 to 230 F.). (In the case of sodium sulfate solution, for the alternature procedure, the anhydrate is formed from the deca-hydrate at the low temperature of 32.4 C. (90.3 F.), and hence is completely dehydrated in the standard procedure.) Therefore, a slight but continued loss can be expected to occur from the hepta-hydrate and the mono-hydrate forms over a very considerable period at these lower temperatures, probably considerably longer than the 30 hr. which Mr. Bloem used in his tests. It is extremely doubtful that any advantage is gained by the complete dehydration of the magnesium sulfate, if that were possible, since it is surely restored to the hepta-hydrate form as soon as it is immersed in the solution again.

The so-called constant-weight attainment is rather a joker anyhow in testing of this sort, since it is a matter of relativity almost altogether, depending upon the accuracy of the balance used with the weight of the sample required and the patience of the operator. Obviously every time a sample is handled, some loss is likely to occur which would show up as a real difference in weight, and thus the attainment of the apparent "constant weight" would be postponed again.

One quite serious effect of prolonged drying was shown by Garrity and Kriege on pages 251 and 252 of the paper referred to above.[4] It was shown that prolonged drying up to 48 hr. has a profound effect destructively on fine aggregate, both of natural and prepared limestone sands, when the immersion liquid is distilled water instead of any of these accelerated soundness salts. The amount of loss after 48 hr. of drying at 105 to 110 C., compared with the 4-hr. drying loss, was from 1½ to 2½ times as great. Also the loss obtained after immersion in distilled water and drying for 48 hr. was greater than the loss obtained with either magnesium or sodium sulfate solutions in the standard procedure with 4 hr. of drying. Evidently, this prolonged drying is a serious and dangerous disturbing element in the test procedure, since it produces sufficiently destructive action on good material to indicate it as being unsound for use according to most specifications.

The foregoing is not an entirely new thought, but has been substantiated in other respects. For example, the modified abrasion loss for prepared aggregates can be affected seriously by the length or temperature of the drying period before the aggregate is placed in the abrasion machine. I would question seriously the desirability of adding a 24-hr. drying cycle to the usual amount required in preparing an abrasion charge for this test just in order to make the test more severe. By the same token, it is not desirable to alter the test procedure by a prolonged drying period just to make the soundness test more severe. In fact, if that end is desired, there are other modifications of the procedure which could more easily be made, such as the evacuation in the immersing solution, maintaining the salt solution at higher temperatures than 70 F., etc., which would increase the severity of the test without question.

Another important item against pro-

[3] Consulting Chemist, Perrysburg, Ohio.

[4] L. V. Garrity and H. F. Kriege, "Studies of Accelerated Soundness Tests," *Proceedings*, Highway Research Board, p. 237 (1935).

longing the drying period beyond 4 to 6 hr. is a serious increase in the time element. Soundness tests take long enough as they are now, without doubling that time element as would be the case with the 30-hr. drying period.

A great deal of information has been acquired by laboratories all over the country checking their aggregates against the soundness test procedures as provided by A.S.T.M. and other organizations. In most cases, the 4 to 6-hr. drying period has been used. To alter the results of the soundness test materially would be a disturbing matter. As a case in a slightly different field, I am thinking of a meeting of Committee C-9 on Concrete and Concrete Aggregates some years ago where the standard method of determining the dry-rodded weight was under discussion. One of the subcommittee members presented data showing what resulted when the number of roddings per layer in the standard container was increased from the specified 25 to 50, 75, and 100 roddings. Similar comparison was made with the jolted or jigged method of compaction for the usual 25 joltings, or with 50, 75, and 100 joltings. In every case the greater number of roddings or joltings increase the compaction of the aggregate in the container. It was immediately proposed by the members present to disregard these values for the simple reason that almost everyone had a fund of data on the 25 unit roddings or joltings, and no one wanted to have these impressions disturbed by some other condition, even though it was immediately recognized that full compaction was not obtained by the conditions of the standard test procedure.

Mr. Bloem states that the soundness test conducted with $6^1/_2$-hr. drying cycle is a probable cause for inaccuracies in test results, and yet his own figures do not support this statement. That is, within the group of triplicate samples, the losses were practically as consistent for the $6^1/_2$-hr. drying series as for the $30^1/_2$-hr. drying series. The statement is also made that the largest losses occurring in the larger sizes were due to the fact that they dried out more readily than did the smaller sizes. While that may be true, it is also possible that the generality "the longer the chain, the more often a weak link will occur" may apply. Surely this is the case with the testing of coarse aggregates, and there is scarcely any reason to believe that the fact alters abruptly when we drop below the No. 4 sieve size and deal with fine aggregates. I think it is well for the reader to keep in mind that the tests were run on fine aggregates only, though some of the deductions and statements are sufficiently general to include coarse aggregates in accelerated soundness tests, as well.

In conclusion, I should like to compliment Mr. Bloem on his work, and to state my agreement with his thesis in calling attention to the importance of the drying period. However, I would suggest that we use his information, which is in confirmation of earlier work, to help fix the length of drying cycle to a specified time, as well as condition, and not make it any longer than it is at present. The addition of a new destructive factor, such as prolonged drying periods produce, is neither an improvement nor a simplification of our accelerated soundness procedure.

MR. D. L. BLOEM (*authors closure, by letter*).—The author wishes to apologize for not having given proper recognition to the fact that the tests reported were part of a cooperative investigation in which the laboratories mentioned by Mr. Meara took part. The omission was entirely unintentional and the author is grateful to Mr. Meara for supplying the additional corroborative data from the three other laboratories.

From Mr. Kriege's discussion it appears that the author's failure to state clearly his purpose in writing this paper has led to some confusion regarding the original intent. Although Tentative Method C 88[5] can well bear examination for possible revision and improvement, the object of this paper was merely to point out a few of the many sources of error which arise when the present method is not followed *to the letter*.

Mr. Kriege's statement that drying to constant weight probably is unnecessary may be true within limits. On the other hand, some reproducible end point in the drying cycle must be established if consistent results are to be obtained. I do not believe that Mr. Kriege's idea of establishing a fixed drying time would solve the problem. The drying efficiency of an oven is affected by too many variables other than temperature to permit assuming that the degree of drying would be assured by merely fixing the number of hours the samples must remain in the oven. The size of the oven, the source of heat used (electricity or gas), type of circulation (convection or forced draft), and heat-producing capacity are some of the variables not taken into account when limitations are placed only on temperature and time.

It is true, as Mr. Kriege states, that, at the temperatures used in this test, magnesium sulfate is not reduced to the anhydrous form, but still contains some water of hydration. This in itself is not important. What is important is that *all* the salt be reduced to the same composition during drying and none of it be allowed to remain in the form of higher hydrates. Since the destructiveness of the test depends principally upon the increase in volume of the salt upon hydrating, it would appear that failure to dehydrate the salt to the lowest form possible for the conditions specified would reduce the severity of the test.

It seems apparent from Table II of the original paper that very little of the salt had been reduced to the low hydrate form in the first $6^1/_2$ hr. of drying. The 150 g. of water removed from twelve 100-g. samples of sand in the period from $6^1/_2$ to 24 hr. is equivalent to the loss of 6 molecules of water from over 340 g. of the heptahydrate salt. Since it is unlikely that there was this much salt on the samples when removed from solution, there was probably a considerable amount of free water present even after $6^1/_2$ hr. in the oven. This free water (as well as the excess volume of the hydrated crystals over that of the lower hydrate forms) occupied pore space in the aggregate which could otherwise have been filled with solution during the next soaking cycle. The amount of salt in the pore spaces during later cycles was thereby reduced below the amount which would have been present if adequate drying had taken place and hence the destructiveness of the test was also reduced.

Mr. Kriege cites the good agreement in results among tests dried $6^1/_2$ hr. as an indication that the establishment of a fixed drying period would result in good agreement between individual tests. This is probably true within the limitations of the tests reported, that is, all samples treated identically within the same laboratory. I do not believe it follows that samples tested in different laboratories and dried in different ovens for the same period of time would give the same results. As shown elsewhere (see Table I of discussion by Mr. F. L. Meara) losses for other samples of the same sand as used by the author, tested by four different laboratories and dried for 6 to $7^1/_2$ hr., varied from 5.1 per cent to 15.6 per cent. Differences in oven drying efficiency are believed to be the principal cause of the wide variation.

[5] Tentative Method of Test for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate (C88–46T), 1946 Book of A.S.T.M. Standards, Part II, p. 1400.

A Means of Determining the Hardness of Wood and Modified Woods Over a Broad Specific Gravity Range

By Richard C. Weatherwax,[1] E. C. O. Erickson,[1] and Alfred J. Stamm[1]

DURING the course of evaluating modified woods at the Forest Products Laboratory for decking purposes, the need arose for a method of test to measure the range of hardness shown by such diverse materials as normal wood over its complete specific gravity range, resin-treated dimensionally stabilized wood ranging from impreg (2, 16)[2] with specific gravities in some cases as low as 0.3 to compreg (2, 17) with specific gravities as high as 1.36, and untreated compressed wood, staypak (14), with specific gravities from 1.2 to 1.4.

The standard American Society of Testing Materials ball-hardness test, which consists in determining the load required to embed a ball with a diameter of 0.444 in. to a depth of half that diameter, is suitable for normal woods (1, 10), but at higher specific gravities the method becomes less selective. In addition, it causes the 6-in. long test specimens of impregnated and highly compressed woods to split before full penetration is reached. On larger specimens of densified wood, it displaces the wood laterally around the tool, and the shoulder thus formed prevents full penetration. The method is, consequently, unsuitable for compreg and staypak.

Before conducting the tests covered by this investigation, available literature was searched to determine whether any established hardness tests for normal wood could be adapted as a hardness test for densified woods. The old German standard hardness test for wood (DIN, DVM C 3011) was a Brinell test using a 10-mm. diameter ball with a 10-kg. load for softwoods, a 50-kg. load for average specific gravity wood, and a 100-kg. load for hardwoods (12). The hardness was recorded as an inverse function of the penetration. This method proved unsatisfactory, chiefly because three different load scales had to be used. In 1906 Janka (8) described the test that has since been adopted as an A.S.T.M. standard for the hardness of wood.[3] Voluminous data have since been recorded for normal woods (9, 10).

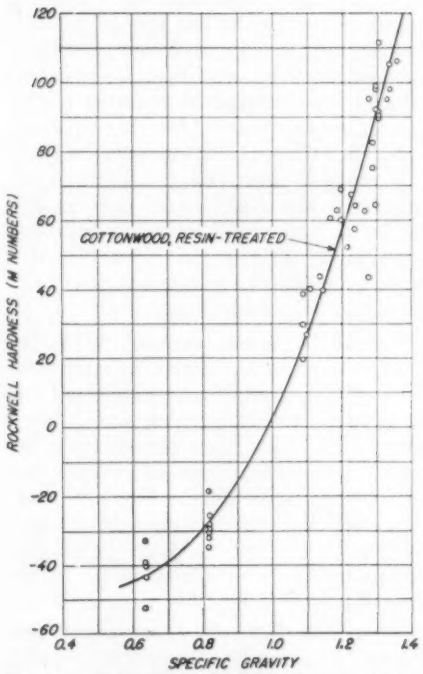

Fig. 1.—Rockwell "M" Hardness—Specific Gravity Relationship of Treated Cottonwood Laminates.

This test has been criticized because of the side stresses present when the ball reaches maximum penetration (12). As a result, methods were developed using larger balls, 25.466 and 31.831 mm. in diameter, that penetrated to a depth of 2.5 and 2.0 mm., respectively, to give a contact area of 2.0 sq. cm. (13). This was done in an attempt to obtain the maximum load per unit area for all woods, and hence the maximum hardness. No attempt was made to extend the test to woods with specific gravities above 0.88. A similar test was developed using a 30-mm. diameter ball (7). With a penetrator of this diameter, the approximate maximum-hardness value per square centimeter was obtained at 1.1-mm. penetration, whereas the maximum value for many woods using the present A.S.T.M. standard method was found to occur at 0.77-mm. penetration. An attempt to measure the hardness of wood with rectangular tools has also been made (6), but with relatively little success.

Preliminary Tests

Preliminary tests were made by Liska at the Forest Products Laboratory to determine whether the Rockwell test using the "M" scale, which has been satisfactorily used for paper-base laminates (3, 4), or other combinations of load and penetrator, could be used for normal wood. Hardness tests on normal wood ranging in specific gravity from 0.35 to 0.75 with both 1/4 and 1/2-in. diameter balls and various constant loads gave hardness-specific gravity curves with decreasing hardness increments per specific gravity increment with increasing specific gravity. The curvature is more pronounced and is the reverse of that obtained with the standard A.S.T.M. test.[3] The test proved to be too sensitive in the low specific gravity range and not sufficiently sensitive in the higher range. More than one tool or load would have to be used to cover properly just the range of normal woods.

Figure 1 shows currently determined Rockwell "M" hardness values for modified cottonwood laminates containing about 33 per cent phenolic resin plotted against the specific gravity of the wood. These data indicate a trend of increasing hardness with increasing specific gravity, although the range

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

[3] Standard Methods of Testing Small Clear Specimens of Timber (D 143 - 27), 1946 Book of A.S.T.M. Standards, Part II, p. 774.

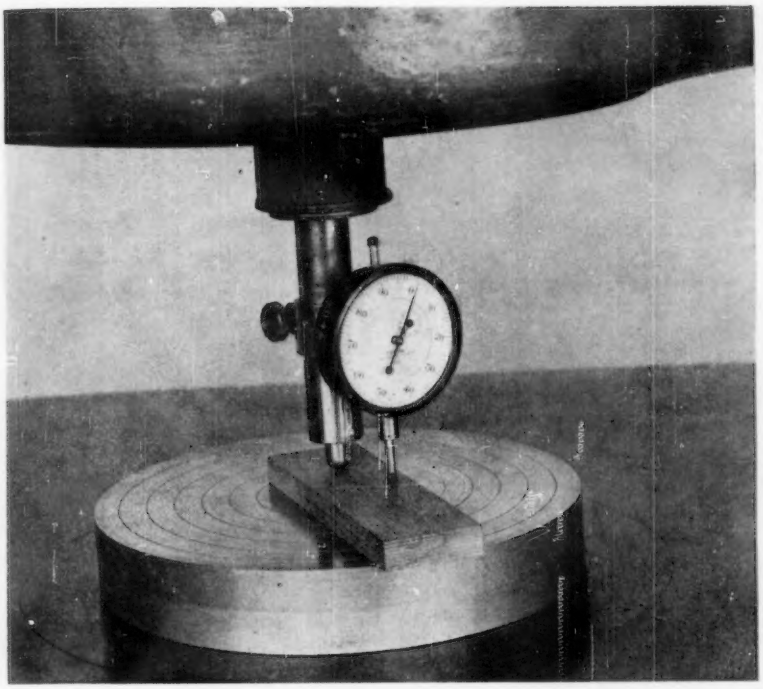

Fig. 2.—Hardness Test of Maple Impreg Showing Modified A.S.T.M. Hardness Tool and Method of Observing Penetration.

in hardness values obtained for any specific gravity is quite large. The Rockwell "M" scale hardness test cannot be used on normal woods of medium or low specific gravity, however, because the ball penetrator indents beyond the range of the apparatus.

Hardness Modulus Measurements

None of the foregoing tests proved suitable for determining the hardness of wood over the full normal-wood plus modified-wood range. In a further attempt to find such a method, the collar was removed from the 0.444-in. diameter ball used in the standard A.S.T.M. hardness test[3] for normal wood. Measurements were made of the penetration, with an accuracy of 0.001 in., under increasing loads in a hydraulic testing machine, in which the load was applied at the uniform rate of 0.02 in. per min. (Fig. 2). The load and the penetration were simultaneously read at convenient intervals. When the applied load P is plotted against the penetration, h, or $2\pi r$ times the penetration (where r is the radius of the ball), which gives the curved surface of penetration, a linear relationship is obtained over the major part of the range of test. This is shown in Fig. 3 for balsa and for high-density birch staypak. The hardness can be expressed in terms of the slope of this straight line:

$$H_M = \frac{P}{2\pi r h} = 0.717\,\frac{P}{h} \quad \ldots\ldots(1)$$

where, H_M is the expression for load per unit of spherical area of penetration expressed in pounds per square inch. The hardness determined this way can thus be called a "hardness modulus," and the subscript M in the symbol distinguishes the value from the normal A.S.T.M. hardness.

Preparation of Specimens

All laminated specimens were made of $\frac{1}{8}$-, $\frac{1}{12}$-, or $\frac{1}{16}$-in. veneers, assembled with a representative hot-press phenolic-resin glue, and cured under sufficient pressure to obtain the desired specific gravity. The bonding resin was cured in the case of the untreated specimens for 30 min. at 315 F., the staypaks for 20 min. at 340 F. (14), and the impreg, semicompreg, and compreg for 30 min. at 315 F. (16, 17). The resin-treated wood was impregnated either with a water-soluble, dimension-stabilizing, phenolic resin (2) by standard methods (16) to various resin contents, or with urea-resin-forming materials (11).

Sulfur-treated panels were made by soaking individual sheets of veneer in melted sulfur at 262 to 293 F. for 20 min. The veneer surfaces were scraped clean, and the panel assembled with a hot-press phenolic-resin glue.

Metal-impregnated birch and Douglas fir samples were prepared by treating $\frac{1}{16}$-in. veneer in an autoclave at 230 F. with the alloy "Cerrobase," which has a melting point of 160 F. A vacuum of 27

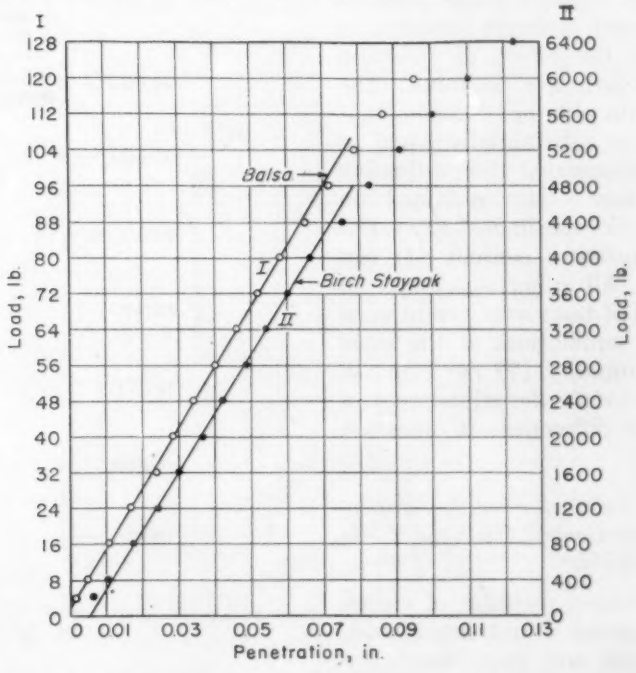

Fig. 3.—Typical Load-Penetration Curves for Balsa (Specific Gravity 0.307) and for Birch Staypak (Specific Gravity 1.36).

in. of mercury was pulled and held for 2 hr. and was followed by 200 psi. air pressure for 1 hr. The surfaces were cleansed of excess metal, and the panel assembled by use of a hot-press phenolic-resin glue.

Staybwood samples were prepared by heating individual plies for 3 min. under the surface of liquid Cerrobase. To obtain about 20 per cent antishrink efficiency (A.S. E.), the temperature was held at 482 to 500 F.; and for 40 per cent efficiency (A.S.E.), at 563 to 581 F. (15).

Discussion of Hardness-Modulus Tests

Effect of Sample Thickness and Moisture Content on the Hardness Modulus:

To determine the effect of sample thickness on H_M, matched samples of yellow birch and of Eastern white pine of varying thickness from 0.090 in. to 1.006 in. were tested following conditioning at 75 F. and 50 per cent relative humidity. It was found that above 0.2 5 in., thickness had no effect on H_M. To provide for an adequate safety factor, all other samples were made at least ½ in. thick.

A few tests were made to obtain the hardness modulus of yellow birch and Eastern white pine at four different moisture contents to determine the effect of moisture upon the hardness modulus., The limited data obtained indicate that a correction substantially equal to that recommended for adjusting side-hardness values obtained on standard size specimens[3] for variation in moisture content (1) can be used. All other specimens in this series of tests were conditioned to weight equilibrium at the same relative humidity (50 per cent) in order to obviate the adjustment of results for differences in moisture content.

Effect of Species, Specific Gravity, and Resin Content Upon the Hardness Modulus:

The hardness modulus of eleven different species of untreated wood, both normal and compressed, are plotted in Fig. 4 against the specific gravity. Table I gives the corresponding data for a representative normal wood of each species, together with data for impreg, compreg, and staypak made from eight of the species. The data given in the table represent only one specimen having about the normal specific gravity, and in the case of resin-treated wood, the normal resin content, in contrast to the figures

TABLE I.—HARDNESS MODULUS OF VARIOUS WOODS AND MODIFIED WOODS.

Material	Specific Gravity[a]	Resin Content, per cent[b]	Load, lb.[c]	Penetration, in.[c]	Hardness Modulus, psi.
Balsa	0.13	0	19	0.0470	290
Basswood	0.44	0	260	0.0950	1 960
staypak	1.32	0	2200	0.0490	32 200
impreg	0.49	37	100	0.0291	2 460
compreg	1.36	37	1000	0.0154	46 500
Birch, yellow	0.61	0	500	0.0950	3 770
staypak	1.36	0	4400	0.0720	43 800
impreg	0.79	39	400	0.0390	7 350
compreg	1.30	39	1000	0.0191	37 500
Cottonwood	0.50	0	350	0.0532	3 370
staypak	1.33	0	2120	0.0400	38 000
impreg	0.64	33	656	0.1000	4 700
compreg	1.31	33	2437	0.0400	43 700
Douglas fir	0.60	0	180	0.0500	2 580
staypak	1.32	0	2400	0.0581	29 600
impreg	0.67	36	182	0.0400	3 260
compreg	1.35	36	2000	0.0280	51 200
Elm, rock	0.53	0	560	0.1690	2 380
staypack	1.33	0	4000	0.0800	35 800
impreg	0.61	33	500	0.0950	3 770
compreg	1.24	33	3000	0.0560	38 410
Maple, sugar	0.70	0	200	0.0260	5 520
staypak	1.33	0	4400	0.0730	43 200
impreg	0.78	31	1400	0.0910	11 030
compreg	1.28	31	3200	0.0560	41 000
Pine, Eastern white	0.39	0	100	0.0480	1 490
Poplar, yellow	0.45	0	100	0.0443	1 620
staypak	1.30	0	1000	0.0253	28 300
impreg	0.50	35	100	0.0321	2 230
compreg	1.28	35	1000	0.0201	35 700
Sitka spruce	0.38	0	100	0.0503	1 430
staypak	1.30	0	1000	0.0242	29 600
impreg	0.46	35	100	0.0391	1 830
compreg	1.36	35	1000	0.0146	49 100
Teak	0.62	0	210	0.0500	3 020

[a] Based on weight and volume at test, following conditioning at 75 F. and 50 per cent relative humidity.
[b] Impregnating-resin content based on dry weight of untreated veneer.
[c] Load and penetration increments that give linear load-penetration relationships.

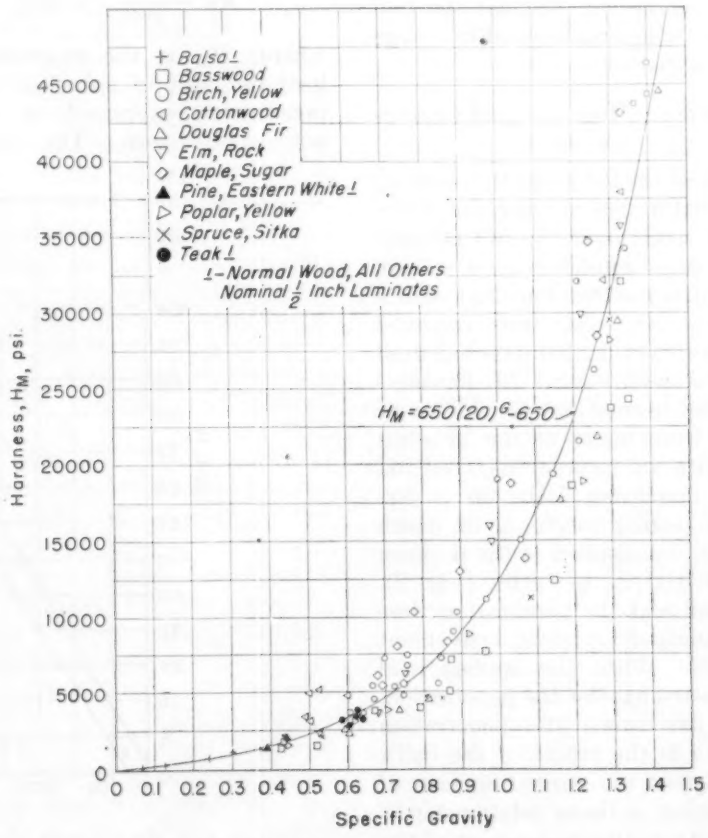

Fig. 4.—Hardness (H_M)—Specific Gravity Relationship of Three Species of Normal Wood and Eight Species of Untreated Modified Laminates.

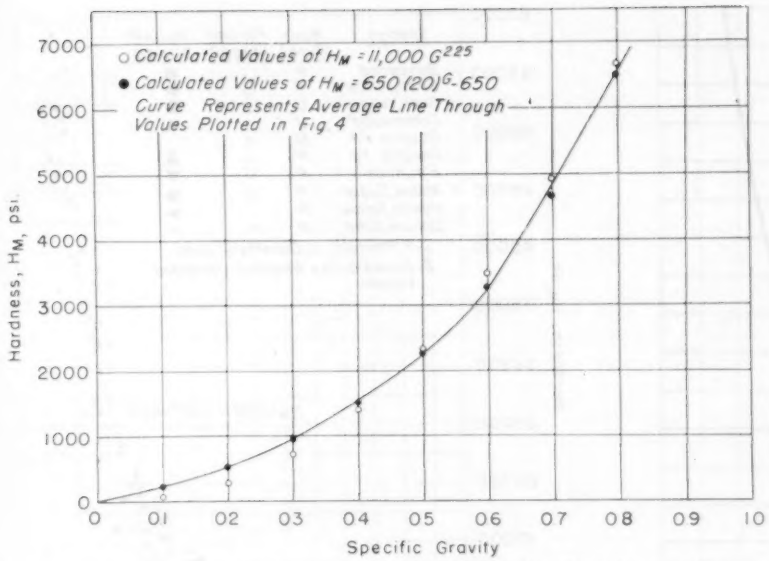

Fig. 5.—Specific Gravity—Hardness (H_M) Relationship for Experimental Data and Calculated Values.

which give all of the data. Figure 5 gives the same curve as that in Fig. 4 plotted over the normal-wood specific gravity range, together with the calculated values for the hardness modulus obtained from the equation:

$$H_M = 11{,}000G^{2.25} \quad \ldots\ldots (2)$$

where G is the specific gravity of the wood. This same form of equation, with the same power of the specific gravity, is used for relating A.S.T.M. hardness with the specific gravity (**10**).

$$H_t = 3820G^{2.25} \quad \ldots\ldots (3)$$

$$H_r = 3720G^{2.25} \quad \ldots\ldots (4)$$

where H_t is the tangential and H_r the radial hardness (**10**).

It is of interest to note that the hardness values obtained from Eqs. 3 and 4 are in pounds, whereas Eq. 2 gives values in pounds per square inch of curved contact surface. If the average multiple constant of Eqs. 3 and 4 is divided by $2\pi rh$ where h is equal to r, then the constant becomes 12,170, a value only 10.6 per cent higher than the constant used in Eq. 2. This means that the slope of the straight line used in obtaining modulus-of-hardness data must, in the case of normal wood, be practically equal to the total load to embed the ball to half its diameter, divided by the area of contact under this condition., The hardness modulus and the A.S.T.M. hardness values are thus closely related over the range in which the A.S.T.M. test applies.

Equation 2 begins to deviate quite appreciably from the experimental values at specific gravities much above 0.8, or below 0.4. For example, Eq. 2 gives a hardness modulus of 21,600 psi. for wood with a specific gravity of 1.35. The experimental value for staypak of this specific gravity is 37,000 psi. The calculated value is thus 41.6 per cent too low. An equation of a different form that fits the data over the whole specific gravity range much better is indicated below:

$$H_M = 650(20)^G - 650 \quad \ldots\ldots (5)$$

The calculated value for the staypak with a specific gravity of 1.35 is 36,300 psi. This varies from the experimental value by only 1.9 per cent. Equation 5, moreover, represents the data better than does Eq. 2 in the low specific gravity range of balsa as is shown in Fig. 5. Equation 2 gives a hardness modulus of 460 psi. for balsa at 0.244 specific gravity. The experimental value is 720 psi. The calculated value is 36 per cent too low. Equation 5, however, gives 700 psi. at a specific gravity of 0.244, a value only 3 per cent too low.

The individual test results plotted in Fig. 4 show considerable deviation from the average curve drawn through the points. Some of this difference is probably due to species and structural differences. It may be noted, also, that the majority of the maple, birch, elm, and cottonwood data are above the average curve, and the fir, spruce, poplar, and basswood data below. Figure 6 shows the better correlation that is obtained with a single

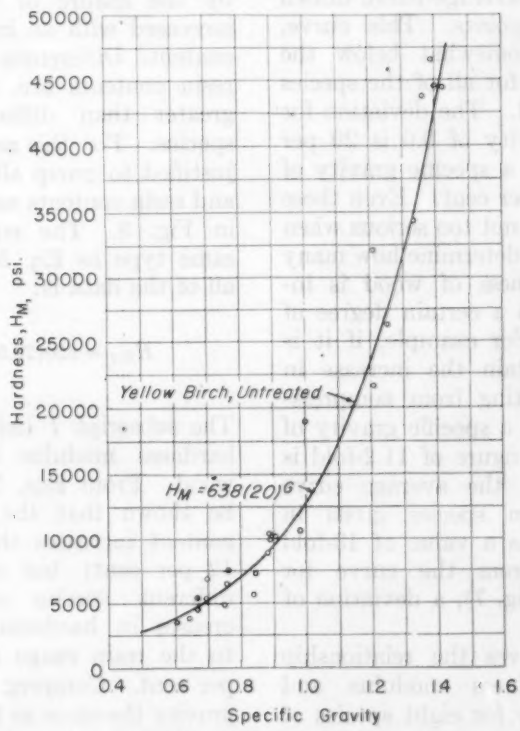

Fig. 6.—Hardness (H_M)—Specific Gravity Relationship of Untreated Yellow Birch Laminates.

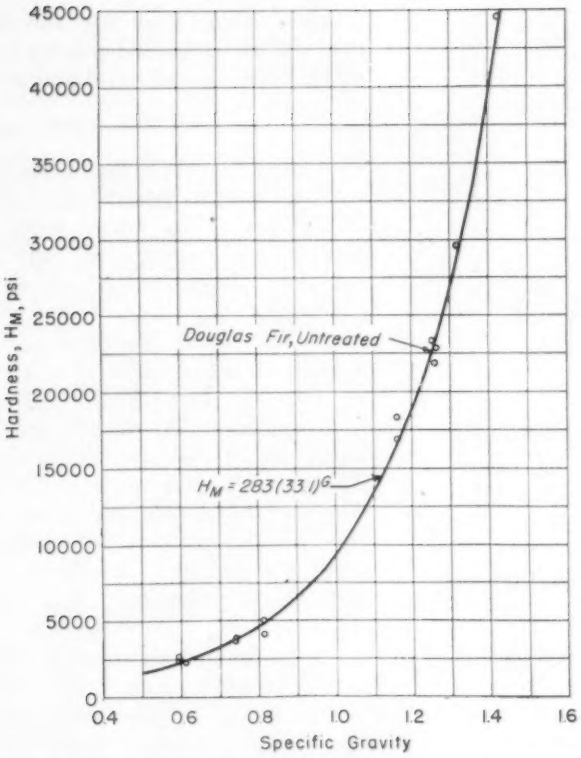

Fig. 7.—Hardness (H_M)—Specific Gravity Relationship of Untreated Douglas-Fir Laminates.

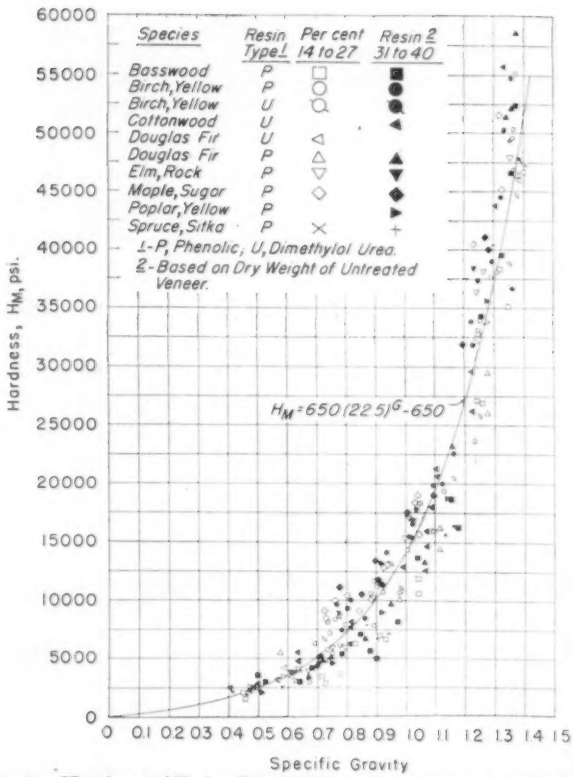

Fig. 8.—Hardness (H_M)—Specific Gravity Relationship of Eight Species of Modified Laminates Treated with Phenol-Formaldehyde or Dimethylol Urea Resins.

species, yellow birch. This curve coincides well with the average curve for all of the species given in Fig. 4. The data for Douglas fir given in Fig. 7 also correlate well with the best average curve drawn through the points. This curve, however, is somewhat below the average curve for all of the species given in Fig. 4. The deviation for a specific gravity of 0.6 is 29 per cent; and for a specific gravity of 1.35, it is 12 per cent. Even these differences are not too serious when it is desired to determine how many fold the hardness of wood is increased due to a certain degree of compression. For example, if it is desired to obtain the increase in hardness resulting from compressing wood with a specific gravity of 0.6 to 1.35, a figure of 11.2-fold is obtained from the average curve for the eleven species given in Fig. 4, whereas a value of 13-fold is obtained from the curve for Douglas fir (Fig. 7), a deviation of 16 per cent.

Figure 8 gives the relationship between hardness modulus and specific gravity for eight species of wood treated with phenol-formaldehyde and with urea-formaldehyde resins in concentrations ranging from 9 to 64 per cent for the phenolic resin and from 9 to 35 per cent for the urea resin. The hardness modulus was affected but slightly by the nature of the resin, but increased with an increase in resin content. Differences due to varying resin contents are, in general, no greater than differences due to species. For this reason, it seems justified to group all of the species and resin contents as has been done in Fig. 8. The equation of the same type as Eq. 5 that best fits all of the data is:

$$H_{M_T} = 650(22.5)^G - 650 \ldots\ldots (6)$$

The subscript T indicates that the hardness modulus is for treated wood. From Eqs. 5 and 6 it can be shown that the average resin content increases the hardness by 12 per cent; but considering the different species separately, increases in hardness modulus due to the resin range from 14 to 24 per cent. Compreg with a specific gravity the same as that of staypak should thus be about 14 to 24 per cent harder than the staypak.

Hardness Modulus of Other Modified Woods, Wood-base Laminates, and Soft Metals:

A limited number of tests were made on other forms of treated wood, the wood impregnants alone, a hydrolyzed wood plastic (5), a high-strength resin-treated paper laminate (papreg) (3), a fabric laminate, and several soft metals in order to determine the variation in hardness modulus between these various materials. These values are given in Table II.

Heating wood to high temperatures to form staybwood seems to increase the hardness modulus slightly when comparing staybwood and normal wood of the same specific gravity. The making of staybwood, however, significantly decreases the specific gravity (15). Hence from a practical standpoint, there is no increase in hardness.

Neither the phenol nor the urea-formaldehyde cast resins used were resins designed for casting purposes, but were resins used in the water-soluble form for treating wood. They are included to show the contributing effect of the resins used

TABLE II.—HARDNESS MODULUS OF IMPREGNATING AGENTS, MODIFIED WOODS, HYDROLYZED-WOOD PLASTIC, PAPER- AND FABRIC-BASE LAMINATES, AND SOFT METALS.

Material	Specific Gravity	Load, lb.[a]	Penetration, in.[a]	Hardness Modulus, psi.
Staybwood				
Birch				
(20 per cent ASE[b])	0.71	800	0.1003	5 720
(46 per cent ASE[b])	0.69	600	0.0810	5 310
Douglas fir				
(20 per cent ASE[b])	0.61	400	0.1050	2 730
(40 per cent ASE[b])	0.61	400	0.1140	2 520
Phenol-formaldehyde resin, cast	1.17	300	0.0081	26 550
Urea-formaldehyde resin, cast	1.41	100	0.0284	2 520
Hydrolyzed-wood plastic	1.40	500	0.0082	43 700
Fabric-base laminate	1.37	640	0.0100	45 900
Paper-base laminate (papreg)	1.41	496	0.0100	35 600
Sulfur (cast)	2.00	200	0.0073	19 640
Sulfur filled				
Yellow birch	0.98	800	0.0580	9 820
Douglas fir	1.30	700	0.0560	8 960
Cerrobase filled				
Yellow birch	3.31	500	0.0330	10 870
Douglas fir	5.14	1000	0.0375	19 120
Aluminum (rolled sheet)	2.70	710	0.0100	50 900
Copper (rolled sheet)	9.01	1280	0.0100	91 700
Brass (rolled sheet)	8.51	1820	0.0100	130 500

[a] Load and penetration increments that give linear load-penetration relationships.
[b] Heated under conditions that give indicated antishrink efficiency.

in treating and should not be used for comparing casting resins.

Hydrolyzed-wood plastics and the fiber-base and paper-base laminates have high hardness values comparable with those for compreg and staypak.

Filling the void capillary structure of wood with sulfur, which itself is considerably harder than wood, increases the hardness of wood significantly, but far short of the amount obtained by compressing the wood to the same specific gravity. Likewise, treating wood with a molten metal (Cerrobase) increases the hardness significantly. The specific gravity increase is, however, far greater than that required to obtain the same hardness by compression.

It is interesting that ordinary rolled-sheet aluminum has about the same hardness as compreg with a specific gravity of 1.4, although the aluminum is almost twice as dense. The other sheet metals, tested, although considerably harder than compreg, have considerably lower specific hardness, that is, the hardness divided by the specific gravity.

Summary

A modified A.S.T.M. hardness test has been developed that can be used for woods ranging in specific gravity from that of balsa (as low as 0.07) to that of compreg and staypak (as high as 1.4). The values are reported in terms of the slope of the load-surface of contact relationship, which is linear over a large range, and are expressed in pounds per square inch., Over the normal-wood specific gravity range, the hardness modulus, H_M, may be expressed in terms of the specific gravity G as follows:

$$H_M = 11{,}000G^{2.25}$$

Over the normal-wood plus untreated modified-wood specific gravity range the hardness modulus can be better expressed by the equation:

$$H_M = 650(20)^G - 650$$

Resin treatment increases the hardness modulus by 14 to 24 per cent.

The modulus of hardness per unit weight is greater for compreg and staypak than for sulfur- and metal-treated wood.

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A Worker-Consistometer for Lubricating Greases*

By S. A. McKee[1] and H. S. White[1]

Synopsis

An apparatus is described for mechanically working a lubricating grease and measuring its flow characteristics in the same series of operations. It consists essentially of two coaxial steel cylinders with a capillary type shearing element located between them. By means of closely fitting pistons the grease under test is forced through the shearing element from one cylinder to the other. In making flow measurements dead weights are used on the down-stroke, and air-pressure on the up-stroke. Provision is also made for automatic mechanical working.

The shearing elements are made by drilling holes in circular steel disks ¼-in. thick, using a No. 79 drill. In order to provide for a range of consistencies, one element has one hole, a second has ten holes, and a third, fifty holes. The results of flow tests using oils of known viscosity with these disks indicate that the Poiseuille equation is applicable for calibration purposes.

Test data are given showing the effect of working upon the flow characteristics of greases. Data are also given which indicate that with some greases changes in the rate of working affects the flow characteristics of the grease. Comparative data are also given for this worker and the regular A.S.T.M. worker.

In general, the performance of the apparatus was adequate for the range of conditions that have been covered. One of its chief advantages is that the grease may be worked and its flow characteristics measured in the same series of operations. Furthermore, a complete series of tests may be made during which the grease is held at all times at a constant test temperature. The small-diameter capillary provides high rates of shear and the use of the multi-hole disks gives sufficient flexibility to cover wide ranges of rates of shear and consistency.

Recent investigations at the National Bureau of Standards on the effect of mechanical working on the physical properties of lubricating greases have been concerned chiefly with the development of an apparatus for working the grease and measuring its flow characteristics in the same series of operations. This apparatus is based upon the principle of the Hain[2] microworker which was developed at the Naval Research Laboratory for the rapid working of small samples of grease.

In this investigation, preliminary tests were made using the Hain worker with suitable modifications to provide for pressure *versus* rate-of-flow measurements at any time during the working operation. This worker employs two glass hypodermic syringes for forcing the grease back and forth through a screen or other shearing element. By mounting the syringes in a vertical position so that known weights could be used to move the plungers, it was possible to obtain flow-pressure data by observing the time for a given movement of the grease. This preliminary apparatus is described in detail in the Appendix.

The flow-pressure data obtained in the tests with the modified Hain apparatus were, in general, satisfactory. However, the apparatus was not especially adaptable for use at other than room temperature, and also the glass syringes were too easily broken. Accordingly, a metal worker of the same general design was constructed to give freedom from breakage and to facilitate mounting for operation at higher temperatures.

Apparatus

The general arrangement of the complete apparatus is shown in Figs. 1 and 2, and the major elements of the worker disassembled in Fig. 3. This worker-consistometer uses two coaxial steel cylinders having a nominal bore of ½ in. and a length of 3⅞ in. One end of each cylinder is provided with a flange by which the cylinders are bolted together with a disk containing the shearing element located between them. In each cylinder there is a hardened steel piston 1⅞ in. long. The diametral clearance between a piston and its mating cylinder is held to a few ten-thousandths of an inch. The assembly of cylinders, piston, and shearing element is enclosed in a vertical steel tube about 7½ in. long which is made from standard 2½ in. pipe. This is encased in an electric heating coil. The ends of the tube are provided with flanges for supporting the entire assembly. Mounted below the lower supporting flange is a brass air cylinder complete with leather-cup piston and rod. The upper end of the rod contacts the lower piston of the worker. Load is applied to the upper piston through a yoke provided with a pan for weights. Temperatures are measured by thermocouples mounted on each of the two cylinders and on the disk holding the shearing element. In some of the earlier tests, temperature was controlled by the manual variation of the voltage to the heater. At present, however, mercury-in-glass thermal regulators are used.

The upper cylinder is filled with 2 in. (about 6.6 cu. cm.) of grease and the apparatus is assembled and placed in position in the tubing support. Weights on the yoke move the upper piston downward forcing the grease through the shearing element. A pointer on the yoke moving along a steel scale indicates the movement of the grease, and the time is observed for the middle 1 in. of the 2 in. of travel. A three-way valve admits air under pressure to the brass cylinder, thus forcing the pistons and grease upward. At the top of the stroke the air pressure is released and the cycle of operations repeated using the same or a different load on the yoke. The air-cylinder piston rod is so weighted that when the air is released it falls quickly away from the lower grease piston and does not impede the downward flow of the grease. A motor-driven lever can be attached to the yoke and air piston rod for automatic working when not timing the rate of flow.

In the Hain worker, fine-mesh wire screen was used as the shearing element. In the preliminary tests with the N.B.S. worker, elements made of 200- and 250-mesh screen were tried. These experiments showed that any one screen was not suitable for covering the desired range of consistency. Furthermore, with some of the heavier greases the force necessary to move the grease through the 200-mesh screen was sufficient to break the screen, while some of the lighter greases flowed through two 250-mesh screens placed in series too fast for accurate timing. These difficulties led to the adoption of a capillary type of shearing element.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters; 1916 Race St., Philadelphia 3, Pa.

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[1] Chief, Lubrication Section, and Physicist, respectively, National Bureau of Standards, Washington, D. C.

[2] George M. Hain, "A Microworker for Lubricating Greases," ASTM Bulletin, No. 147, August, 1947, p. 86.

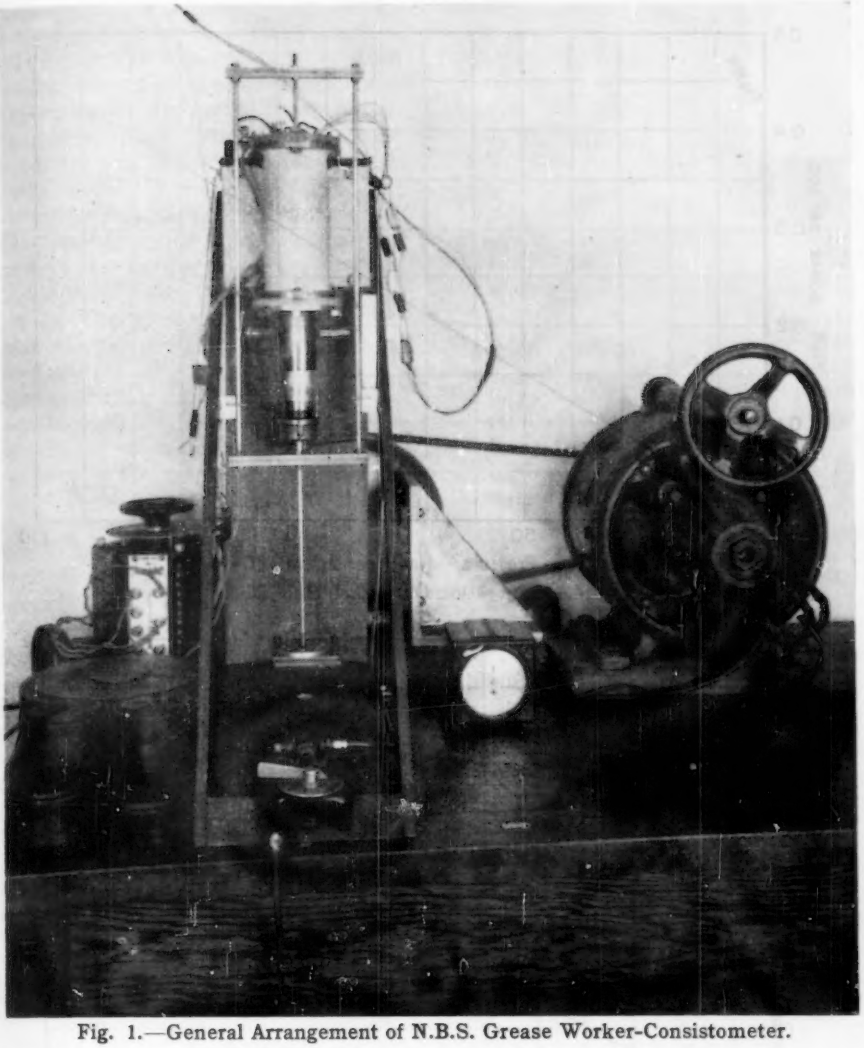

Fig. 1.—General Arrangement of N.B.S. Grease Worker-Consistometer.

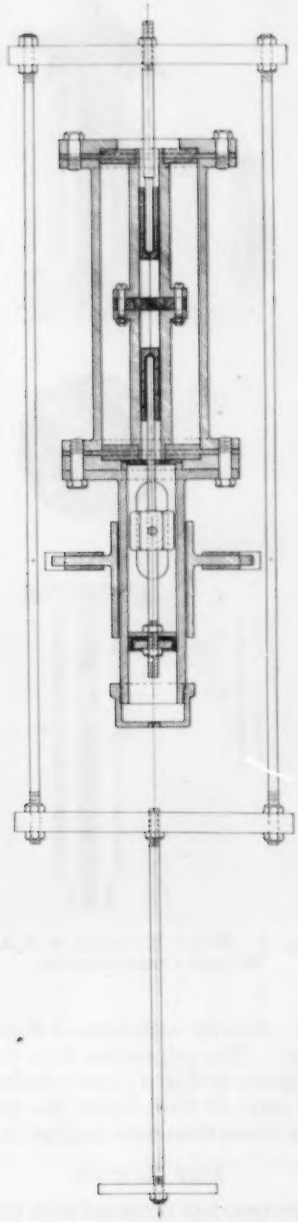

Fig. 2.—Cross-section of N.B.S. Worker-Consistometer.

Three of these elements were made by drilling holes in circular steel disks $\frac{1}{4}$ in. thick, using a No. 79 drill, giving capillaries $\frac{1}{4}$ in. long and approximately 0.015 in. in diameter. In order to provide for a range of consistencies, the first element has one hole, the second, ten holes, and the third, fifty holes. Some of the advantages of these disks over the screen type of element are much greater mechanical strength, the use of the same size openings for all grades of greases, and the applicability of the Poiseuille equation for calibration purposes.

Calibration

Calibration tests were made with the instrument using four oils of known viscosity. The operating temperatures ranged from 76 to 300 F. and the viscosity range was from 0.302 to 764 poises. The data obtained in the tests with the 1-hole disk are given in Fig. 4, where η/t, the absolute viscosity of the oil at test temperature divided by the time of flow for the middle inch of travel of the pistons (about 3.3 cu. cm. volume), is plotted against p, the pressure exerted by the weights moving the upper piston. The points shown are the average values of a number of observations obtained at a given value of p. These data fall on a straight line passing through the origin, and hence the flow in the instrument can be represented by the equation,

$$\eta/t = Kp \text{ or } \eta = Kpt \ldots\ldots (1)$$

where K is the instrument constant. With the 1-hole disk, $K = 3.05 \times 10^{-8}$ when t, the time for 3.30 cu. cm. of flow, is expressed in seconds, η in poises, and p in dynes per square centimeter.

Similar data for the 10-hole disk and the 50-hole disk are given in Figs. 5 and 6, and the values of K obtained with these disks are 25.9×10^{-8} and 116×10^{-8}, respectively.

The data obtained in these tests indicated that over the range covered the effect of temperature on the value of K for a given disk was relatively small and could be neglected.

Part of the resistance to the motion of the pistons in this apparatus is caused by the shearing of the oil in the clearance spaces between the pistons and the walls of the cylinders. This effect was determined by making direct measurements of the rate of motion of the pistons under various loads when the apparatus was filled with oil but without the shearing element between the cylinders. The data obtained were in good agreement with computations of the viscous shear based on measurements of the clearances and the areas under shear. The magnitude of this effect is shown in Figs. 4, 5, and 6 by the lines labeled "piston."

Computations indicate that the kinetic-energy correction is appreciable only with the 1-hole disk when operat-

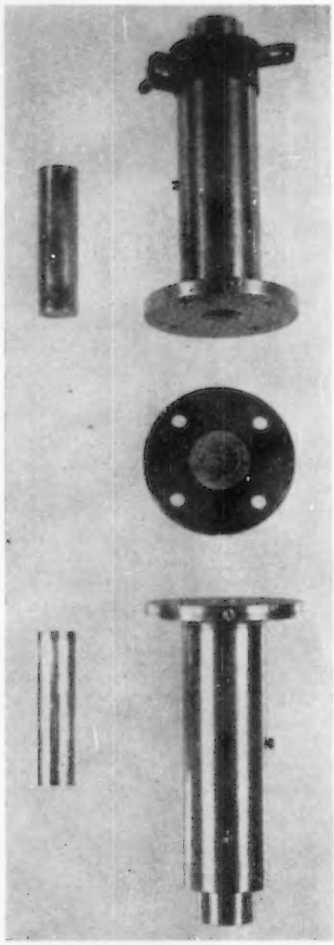

Fig. 3.—Major Elements of N.B.S. Worker-Consistometer.

ing at relatively high rates of flow ($t <$ 10 sec.). The calibration data for this disk (given in Fig. 4) were obtained at lower rates of flow, hence the kinetic-energy corrections were negligible.

Test Results

Some test data obtained with this apparatus are given in Fig. 7 where the rates of flow in cubic centimeters per second obtained at a number of different loads with grease A (lithium soap, A.S.T.M. penetration 229)[1] are plotted against the number of times the grease has passed through the 1-hole shearing element, with the operating temperature at 300 F. At the start of this test, flow observations were made successively at each of the loads and the series repeated until several measurements had been made at each load. The motor-driven lever was then attached and the apparatus worked automatically for a number of passes. These sequences of flow measurements and automatic working were then carried on for the duration of the test. The loads used to obtain

[1] A.S.T.M. Tentative Method of Test for Consistency of Lubricating Greases and Petrolatum (D 217–44 T), 1946 Book of A.S.T.M. Standards, Part III-A, p. 846.

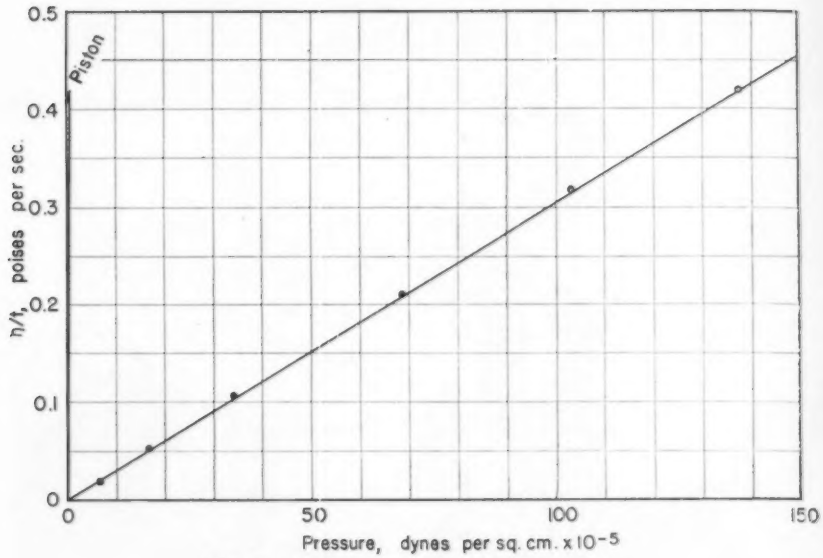

Fig. 4.—Calibration Data for 1-Hole Disk.

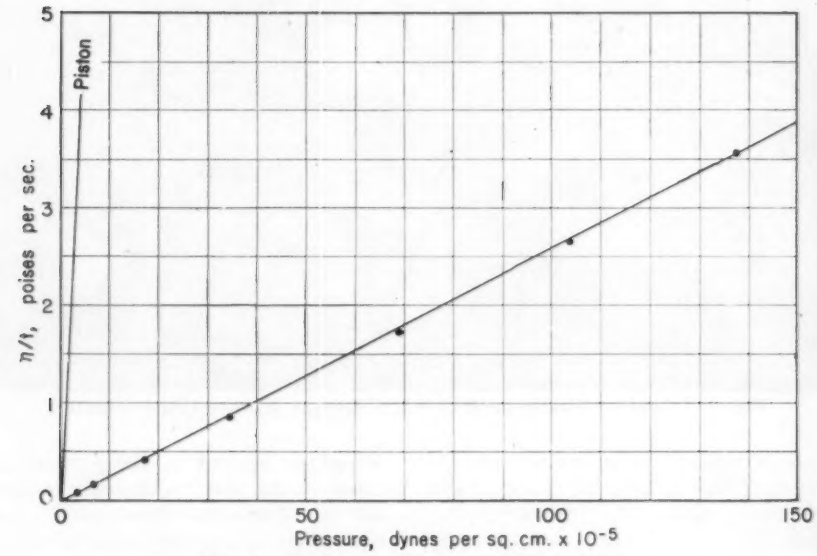

Fig. 5.—Calibration Data for 10-Hole Disk.

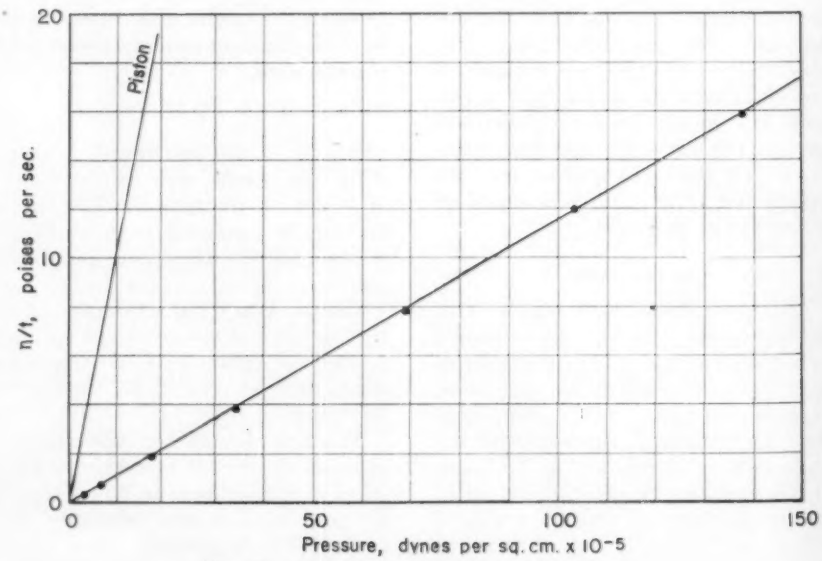

Fig. 6.—Calibration Data for 50-Hole Disk.

the flow data are indicated on the curves in the figure.

The curves in Fig. 7 may be used to obtain flow-pressure curves for any given pass of the grease through the shearing element. Such curves (corrected for the effect of kinetic energy where necessary) are given in Fig. 8, where the rate of flow in cubic centimeters per second is plotted against the pressure in dynes per square centimeters for the 10th, 50th, 200th, 600th, 1200th and 2400th passes, respectively. If desired, the values of the intersections of these curves with a horizontal line representing a given rate of flow may be used to compute (by means of Eq. 1) the effect of working upon the apparent viscosity of the grease at that rate of flow. These data are shown in Fig. 9, where the apparent viscosity in poises at the rates of flow indicated on the curves is plotted against the number of passes.

Curves similar to those in Figs. 7 and 8 were obtained for grease B (lithium soap, A.S.T.M. penetration 209),[3] using the 10-hole disk and operating at 100 F. as shown in Figs. 10 and 11.

The choice of the particular size and number of holes used in the shearing elements was based on a limited experience with the wire screens. It was found, however, that they will operate reasonably well over a temperature range from 100 to 300 F. with a fairly wide range of greases.

One consideration for the use of the multi-hole disks for the harder greases was that with either the 1-, 10-, or 50-hole disk the grease under test passes once through the same size hole with each stroke of the pistons. This is an advantage from the standpoint of working the grease. It is also important in the measurement of flow, since the measured flow characteristics of non-Newtonian substances are dependent upon the dimensions of the capillary.

In considering the data given in Figs. 7 to 11 it should be noted that in general with this instrument the greases are worked at considerably higher rates of shear than with the A.S.T.M. worker.[3] Computations indicate that in the tests of grease A with the 1-hole disk (Fig. 7) the rate of shear at the highest observed rate of flow was about 100,000 reciprocal seconds and the rate of shear during the periods of automatic working with the motor-driven lever averaged about 180,000 reciprocal seconds. Corresponding values when testing grease B with the 10-hole disk (Fig. 10) are 11,000 and 19,000 reciprocal seconds, respectively.

These calculations were made using the equation:

$$S = \frac{4(V/t)}{\pi r^3} \quad \ldots\ldots\ldots\ldots (2)$$

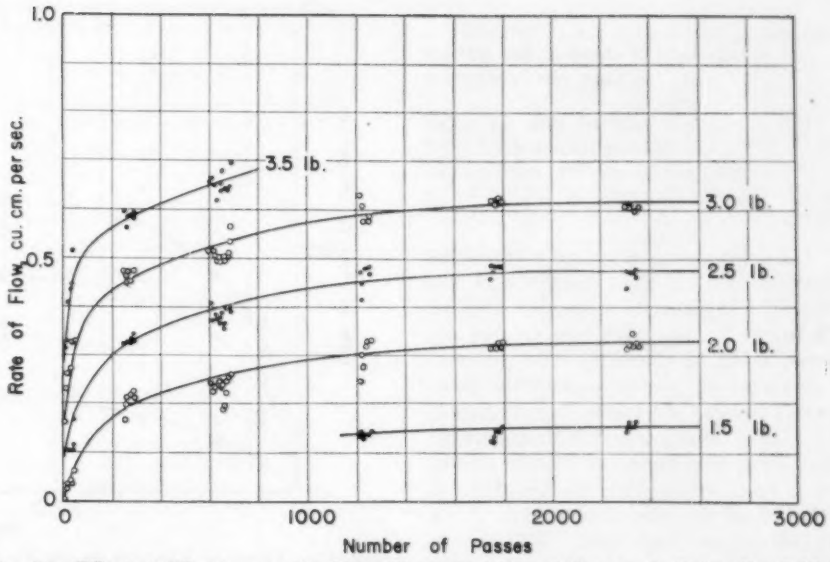

Fig. 7.—Effect of Working on the Flow Characteristics of Grease A, Using the 1-Hole Disk at 300 F.

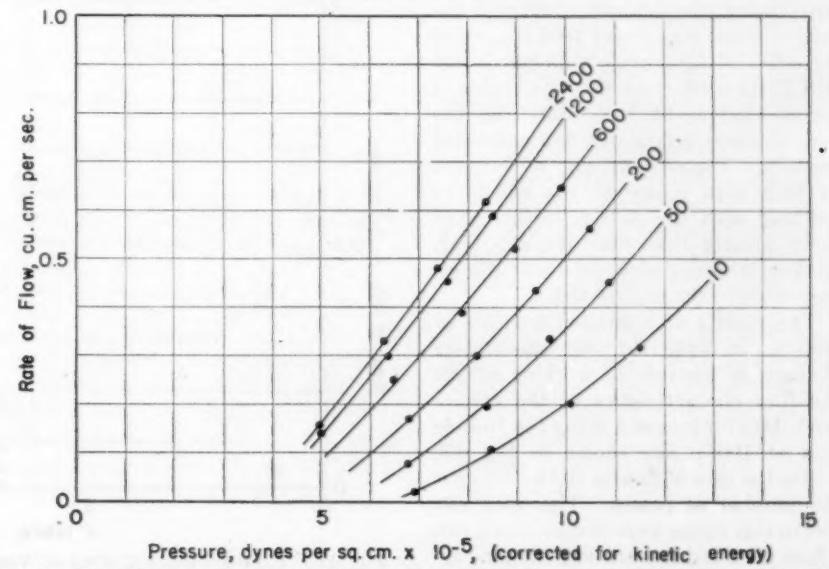

Fig. 8.—Flow-Pressure Curves at Various Passes with Grease A, Using the 1-Hole Disk at 300 F

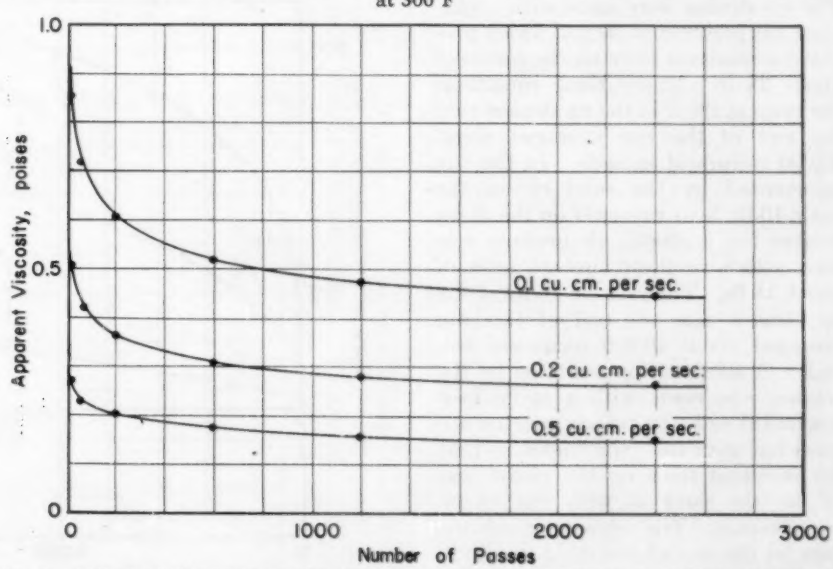

Fig. 9.—Effect of Working on the Apparent Viscosity of Grease A at Various Constant Rates of Flow at 300 F.

where:

S = the rate of shear at the wall of the capillary in reciprocal seconds,

V/t = volume rate of flow in cubic centimeters per second, and

r = the radius of the capillary in centimeters.

Data providing a direct comparison between the N.B.S. worker and the A.S.T.M. worker are somewhat limited. However, results with two greases are given in Fig. 12 where the micropenetration values are plotted against the number of passes. In the tests with grease C (lithium soap) the N.B.S. apparatus was operated with the automatic worker at 5 rpm. using the 10-hole disk at 100 F. and the rate of shear was about 19,000 reciprocal seconds. With grease D (sodium soap), the apparatus was operated at the same speed and temperature, using the 50-hole disk and the rate of shear was about 3800 reciprocal seconds. Both greases were run in the A.S.T.M. worker at 60 rpm. using a plunger having 51 $\frac{1}{4}$-in. holes and the rate of shear was about 385 reciprocal seconds. These data are of interest in that with grease C the effects of working with the N.B.S. worker were much greater than with the A.S.T.M. worker, whereas with grease D the effects were in the reverse order.

The results of a limited number of tests also indicate that with some greases changes in the rate of working affects the flow characteristics of the grease. Such data for grease A using the 10-hole disk at 100 F. are shown in Fig. 13, where the rate of flow is plotted against the number of passes. The open circles in this figure were obtained in a run where all the down strokes (flow measurements) were made with a 10-lb. load. The up strokes were made with a constant air pressure of 30 psi. which provided a resultant force on the piston of about 38 lb. Under these conditions the rates of shear in the up strokes near the end of the run averaged about 45,000 reciprocal seconds. In the run represented by the solid circles the same 10-lb. load was used on the down strokes but a 15-psi. air pressure was used with a resultant upward force of about 18 lb. The rates of shear of the up strokes near the end of this run averaged about 10,000 reciprocal seconds. A third run, represented by the crosses, was made with a 10-lb. load downward and a 30-psi. air pressure upward but with the yoke loaded so that the resultant force on the piston was 18 lb., the same as with the 15-psi. air pressure. The agreement of the data for the second and third runs indicates that the higher rates of flow obtained in the first run were caused by

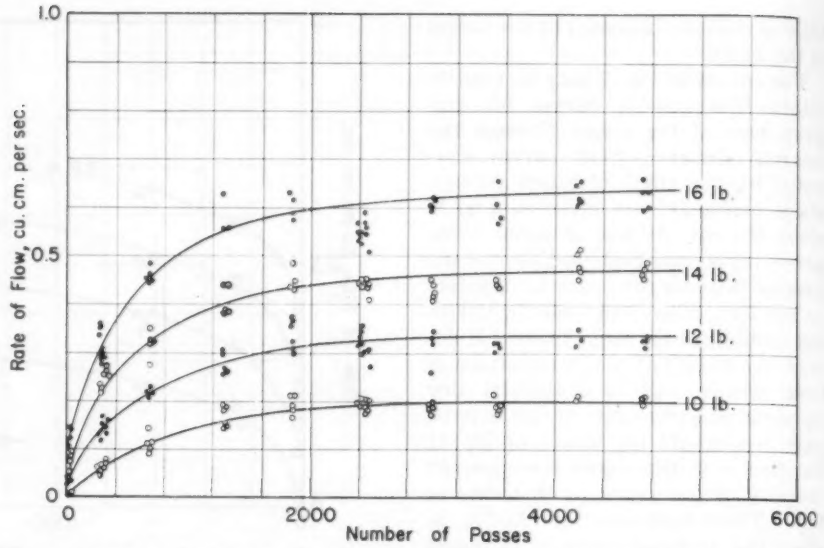

Fig. 10.—Effect of Working on the Flow Characteristics of Grease B, Using the 10-Hole Disk at 100 F.

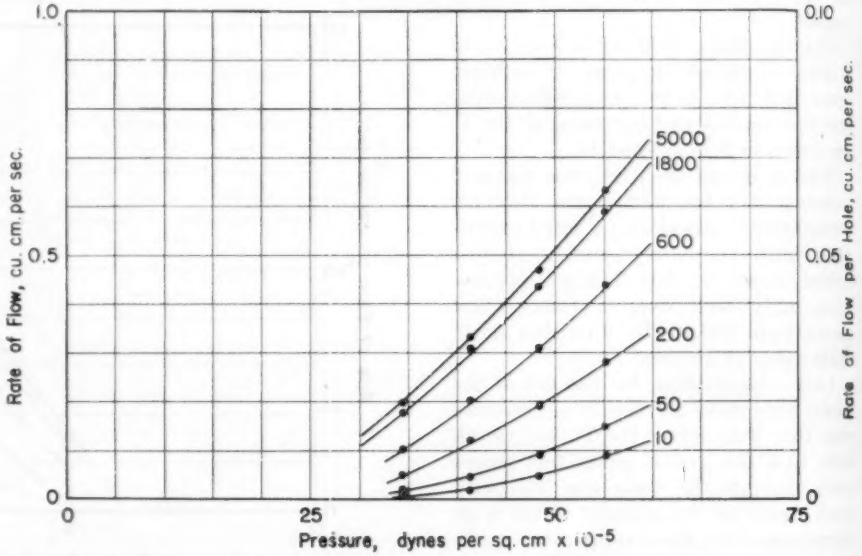

Fig. 11.—Flow-Pressure Curves at Various Passes with Grease B, Using the 10-Hole Disk at 100 F.

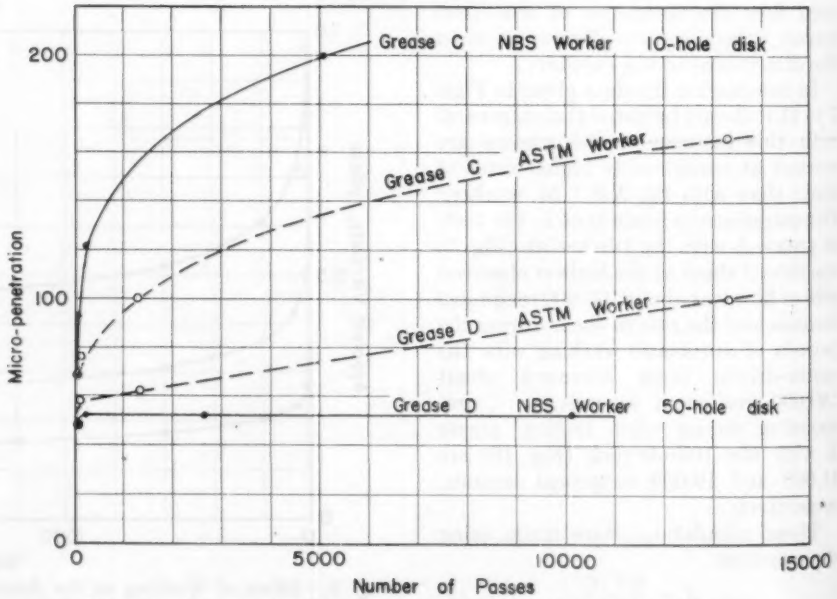

Fig. 12.—Comparative Data with the N.B.S. and A.S.T.M. Workers.

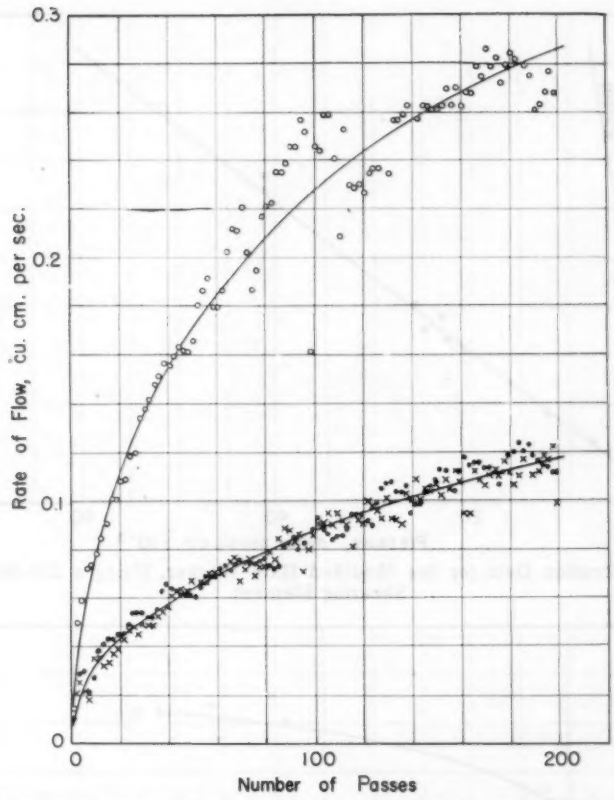

Fig. 13.—Effect of Change of Rate of Working on the Flow Characteristics of Grease A, Using the 10-Hole Disk at 100 F.

the increase in the rate of working and not by the increase in pressure on the grease during the up stroke. Since all the flow measurements were made at the same load, the differences shown indicate definite changes in the flow characteristics of the grease.

Some evidence that the effects shown are not transient was obtained in the second run where the grease was allowed to stand overnight in the apparatus after 135 passes had been made. It will be noted that the data obtained in the subsequent passes show the same general trend as those obtained the previous day.

Similar test data for grease D using the 50-hole disk at 100 F. are shown in Fig. 14. These runs were also made with a 10-lb. load on the down strokes and the 30-psi. (open circles) and 15-psi. (solid circles) air pressures, and the corresponding rates of shear on the up strokes were 5000 and 1500 reciprocal seconds, respectively. These data are of interest in that the higher rate of working on the up strokes caused a definite reversal of flow characteristics after the first few passes. In this connection it should be noted that the "flat" curve for this grease in Fig. 12 was obtained at a rate of shear of 3800 reciprocal seconds which is intermediate to the rates used in these tests. Data were also obtained with this grease using the 50-hole disk at 200 F. but with the load on the down stroke and the air pressures on the up stroke decreased so that the rates of shear were about the same as in the tests at 100 F. These are shown in Fig. 15, and it will be noted that at this temperature the reversal occurs at both rates of working.

Conclusion

The data that have been presented indicate that the apparatus described may provide a useful tool for the study of lubricating greases. One of its chief advantages is that the grease may be worked and its flow characteristics measured in the same series of operations. Furthermore, a complete series of tests may be made during which the grease is held at all times at a constant test temperature. The small-diameter capillary provides high rates of shear. The multi-hole disks give sufficient

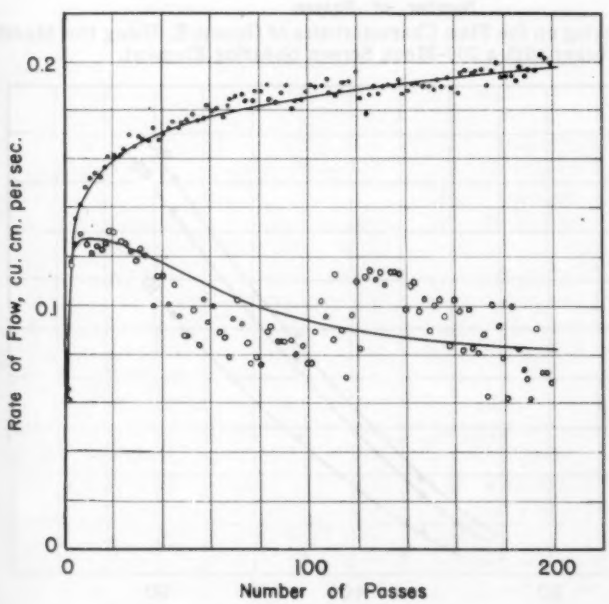

Fig. 14.—Effect of Change of Rate of Working on the Flow Characteristics of Grease D, Using the 50-Hole Disk at 100 F.

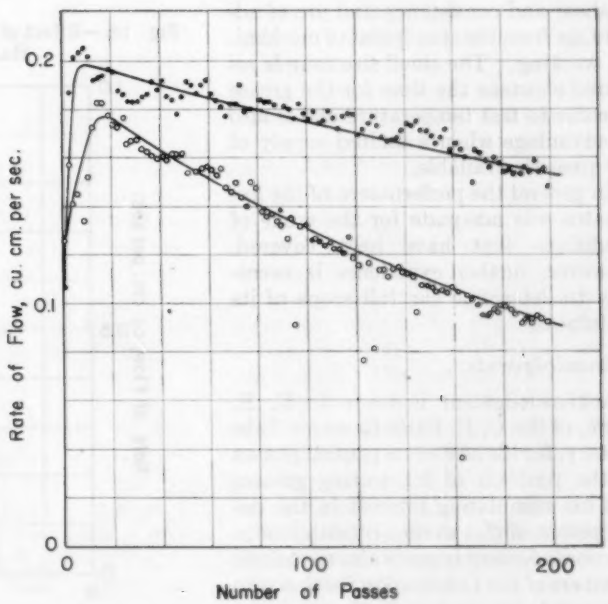

Fig. 15.—Effect of Change of Rate of Working on the Flow Characteristics of Grease D, Using the 50-Hole Disk at 200 F.

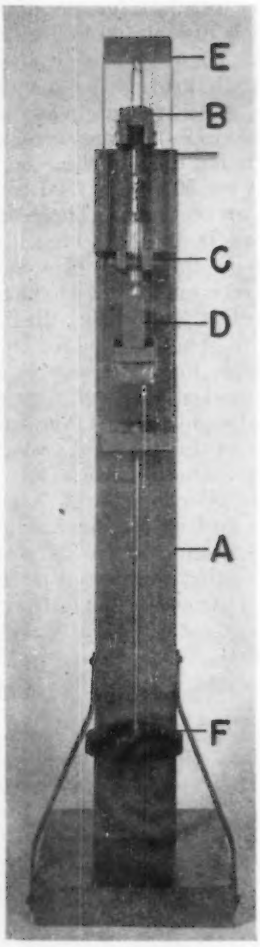

Fig. 16.—The Hain Worker with the N.B.S. Attachments for Flow Measurements.

flexibility to cover wide ranges of rates of shear and consistency and are of advantage from the standpoint of mechanical working. The small size sample required shortens the time for the grease to come to test temperature and is also of advantage when a limited supply of the grease is available.

In general the performance of the apparatus was adequate for the range of conditions that have been covered. However, further experience is necessary to determine the full scope of its usefulness.

Acknowledgments:

Acknowledgment is made to C. E. Earle, of the C. E. Earle Research Laboratory, for his advice on general phases of the problem of lubricating greases and his stimulating interest in the development of this worker-consistometer. Acknowledgment is made also to various members of the Lubrication Section who also assisted including J. F. Swindells, Mrs. A. R. Fritz, Miss H. V. Belcher, and Miss Florence Vine.

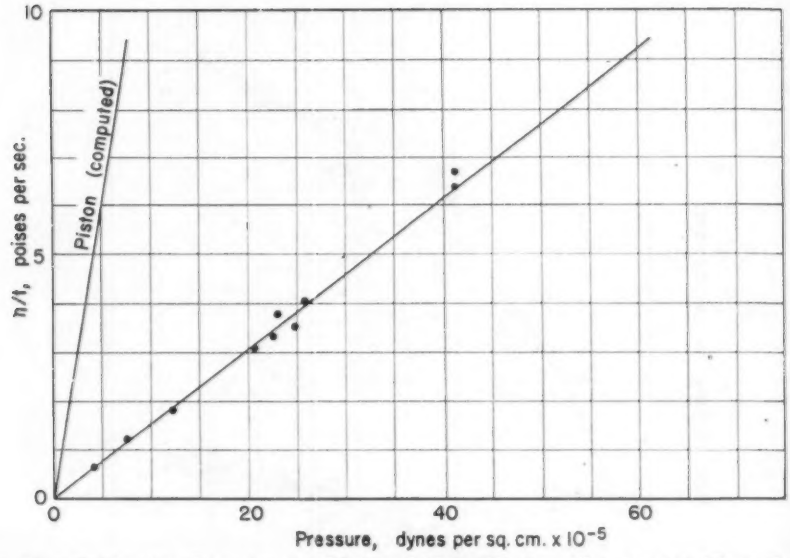

Fig. 17.—Calibration Data for the Modified Hain Worker, Using a 200-Mesh Screen Shearing Element.

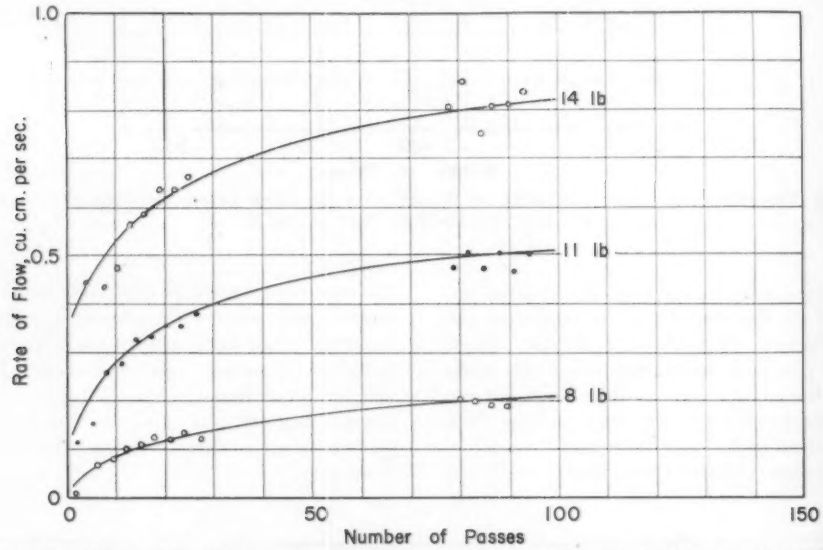

Fig. 18.—Effect of Working on the Flow Characteristics of Grease E, Using the Modified Hain Worker with a 200-Mesh Screen Shearing Element.

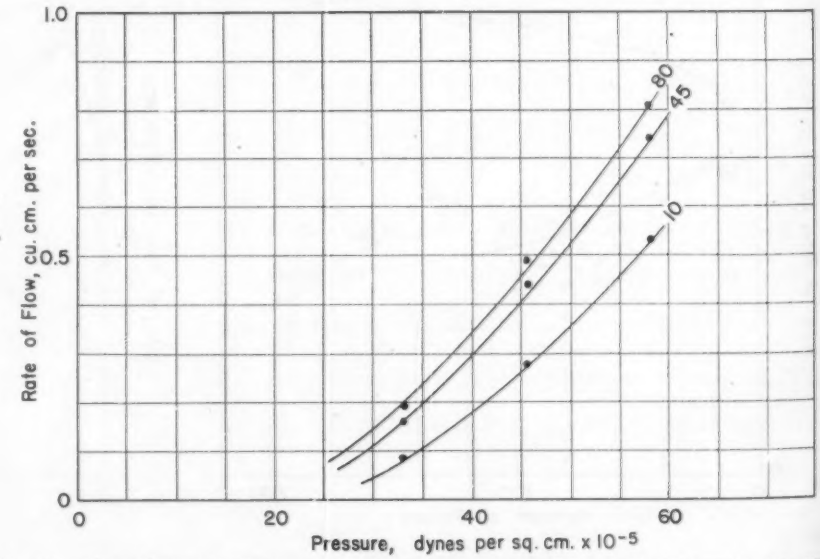

Fig. 19.—Flow-Pressure Curves at Various Passes with Grease E, Using the Modified Hain Worker with a 200-Mesh Screen Shearing Element.

APPENDIX

THE N.B.S. MODIFICATIONS TO THE HAIN WORKER

The Hain worker with the attachments for flow measurements is shown in Fig. 16. The worker assembly consisting of the two hypodermic syringes and working element is mounted in a vertical position in the stand *A*, and is supported by the block *B*, which is slipped on the upper syringe before assembly. The lower end of the worker is guided by the yoke and pin *C*. To make a flow measurement, 5 cu. cm. of grease are placed in the upper syringe and the wedge *D* is placed under the lower plunger. The loading yoke *E* is placed on the upper plunger and a suitable weight put on the loading pan *F*. The wedge is then pulled out and the time is observed for the upper plunger to move from the 4 cu. cm. mark to the 1 cu. cm. mark on the upper syringe, a volume of flow of 3 cu. cm. in the middle of the stroke of the plunger.

The loading yoke is then removed and the worker reversed in the frame. This is readily accomplished without disturbing the grease by withdrawing pin *C*, lifting the worker from the frame, sliding block *B* over to the opposite syringe, and then remounting the worker in the frame. The apparatus is then ready for a second flow observation.

Flow-pressure data can be obtained with each stroke of the worker if desired. In making the tests, however, it was found convenient to omit flow measurements for a number of passes during a test with a given grease.

The shearing element used in most of the tests with this apparatus was a 200-mesh screen having a circular working area of about 11.3 sq. mm. (3.8-mm. diameter). With this construction there are about 700 small square openings, the sides of which are approximately 0.074 mm. Calibration data obtained with this screen are given in Fig. 17 where η/t is plotted against p. These data can be represented by Eq. 1 and the value of K is equal to 152×10^{-8} when expressed in the same units. Calculated values for the resistance of the piston are represented in the figure by the line labeled "piston."

The results of a test of a grease with this apparatus are given in Fig. 18 where the rates of flow obtained at three different loads are plotted against the pass number. Flow-pressure curves obtained from these data for the 10th, 45th, and 80th passes are given in Fig. 19. Except for the limitations previously mentioned, this worker operated satisfactorily.

DISCUSSION

MR. GUS KAUFMAN[1] (*presented in written form*).—The authors have made a very thorough study of their instruments in that they have considered the major corrections involved in the measurement of flow, that is, kinetic energy correction for the fluid when passing through the orifices, temperature effects, piston friction, and pressure required to shear the fluid between the cylinder wall and piston. The apparatus described by the authors may well be considered by Section IV of Technical Committee G of A.S.T.M. Committee D-2 in its work on the thixotropy of greases. One important advantage of the apparatus in work of this nature compared to the circulating capillary viscometer is the fact that the grease passes through the capillary plate only and not through a pump. Therefore, the amount of working to which the grease is subjected is more definitely known.

The equipment described by the authors lends itself to low temperature work since it can be placed in a low temperature cabinet for such purposes. One possible additional use of the equipment suggests itself. Since extremely low pressures may be used to extrude the grease through the capillaries, an extremely low rate of shear can be obtained which would be useful for the determination of yield values.

The authors have made a very worthwhile contribution to the general subject of working of greases, and it is hoped that they can continue with this work since there is a need for information of the fundamental behavior of greases.

MR. L. C. BRUNSTRUM[2] (*presented in written form*).—General use of the single-pass S.O.D.[3] or Precision pressure viscometer led to a widespread desire for a multipass or worker-viscometer. The apparatus in question fulfills the need in several important respects by providing the advantages of (1) low cost, (2) small sample requirement, (3) a simple and accurate means of applying and measuring the shearing force, and (4) simplicity of operation. I believe it has two serious limitations—that of being a fixed stress rather than fixed shear device and being limited to relatively high shear rates.

Of less importance is the latter which is occasioned by the very wide range of stress encountered in the testing of lubricating greases. If time is of no consequence this disadvantage is minor, but it can be roughly estimated that for a stiff grease several hours would be required per pass at shear rates approaching the lower limits of the well-established S.O.D. viscometer. Furthermore, the force requirements with a soft product would be so low that friction would not be negligible.

Undoubtedly the former, the lack of preselected, fixed shear rate, is the more troublesome. Before the pioneering work of Arveson some fifteen to twenty years ago, variable shear-rate instruments provided but little useful information on grease flow. Now it is generally accepted that control of shear-rate is essential for reproducible testing of flow of grease, be the means viscometry, torque measurement, or dispensing. Although controlled shear-rate viscometers are far more complicated than the present apparatus, more costly and perhaps somewhat less precise, this reviewer believes the results obtained are less misleading.

For example, as pictured in Fig. 13, a grease is worked 200 passes at variable shear-rate terminating at approximately 45,000 reciprocal seconds. The fixed force employed requires that the 28 to 1 increase in flow rate reflects a 28-fold decrease in viscosity. This is correct as far as it goes. However, the decrease in viscosity is due to two causes, working down and increasing shear rate. It is necessary to separate these before we can know how much the sample worked down. This can be done only by comparing the successive passes plotted in the figure with an unworked test made at the shear rate of each successive pass. We cannot compare an unworked viscosity at one shear rate with a worked viscosity at any other shear rate because for most greases the change in viscosity with shear rate is significant. The authors do not elaborate on the nature of sample A, but assuming it is of medium soap content and oil viscosity, we might expect a viscosity decrease of about 10 to 1 over the range of 1600 to 45,000 reciprocal seconds. On this basis about a third of the apparent loss in viscosity on working the sample 200 passes is caused by comparing the runs at different shear rates.

It may be of interest to suggest a possible explanation of the relatively

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[2] Group Leader, Standard Oil Co. of Indiana, Whiting, Ind.

[3] This instrument was developed by the Standard Oil Development Co.

smaller effect of the N.B.S. machine over the A.S.T.M. worker on soda grease D and lithium grease C, respectively, as shown in Fig. 12, and of the smaller effect of higher shear rates on sample D in Fig. 14. It is caused by a characteristic of soda greases well known to grease manufacturers. The change in consistency on working is a result of two conflicting trends, breaking fiber length and more effectively dispersing the soap. Transmission greases, for example, may work down and leak, or in other cases be milled between the gear faces at high shear rate, increasing in consistency to a point where they are thrown and remain on the walls of the gear case. Highly dispersed lime and lithium greases are not subject to this action.

A point concerning the validity of using one-, ten-, and fifty-hole plates might be raised. Strictly, this is permissible only if plug flow is known to exist in the cylinders. While the plate probably limits hyperbolic flow, there is no assurance that equal amounts of grease flow through every hole, a condition necessary for shear-rate calculations.

The authors are to be congratulated for this major contribution to the knowledge of working of lubricating grease. Their efforts will undoubtedly lead to a more scientific approach to the problem than has been contemplated by the grease industry in recent years.

MR. N. J. GOTHARD[4] (*presented in written form*).—The authors are to be congratulated for an interesting paper and a timely contribution to our knowledge of the apparent viscosity of lubricating greases from working. They have opened up a new field, over the single pass S.O.D. pressure viscometer, in developing a simple multi-pass worker viscometer. This apparatus is a step beyond the Hain microworker and appears to be a distinct improvement over it in the use of metal cylinders instead of glass, which gets away from breakage, and in the use of a capillary hole type of shearing element instead of wire screens. The advantages of this type of shearing element over wire screens, as discussed by the authors, are apparent. However, in the cases of the disks using ten and fifty holes, I am inclined to question, with Mr. Brunstrum, the validity of shear-rate calculations unless it is established that equal amounts of grease flow through each hole.

Since I am the chairman of a subcommittee to study the motorized worker (above sixty strokes) and the Hain microworker, I presume that I was asked to discuss this paper in its relation to the motorized grease worker and the Hain microworker. The new motorized A.S.T.M. grease workers have only just been delivered so that it has not been possible to do any work with them. However, it seems apparent that the work of the authors in developing this apparatus has gone far beyond the A.S.T.M. worker. The latter will, I believe, always be a useful and widely used piece of apparatus for manufacturing control work, but the McKee and White apparatus, in its development of an apparatus for working greases and measuring their flow characteristics in the same series of operations, offers distinct possibilities which the A.S.T.M. worker cannot attain.

It appears to me, if some of the questions raised can be satisfactorily answered and if further use of the McKee and White apparatus demonstrates its apparent usefulness, that it may well become a standard piece of equipment for grease laboratories and might be substituted for, or used in conjunction with the S.O.D. viscometer. In order that this viscometer may be studied further, it seems to me that a study of it should be made and that the matter should be referred to the same subcommittee, or group, which is standardizing the S.O.D. viscometer, or to another group to be set up.

MESSRS. S. A. MCKEE AND H. S. WHITE (*authors' closure*).—With reference to Mr. Brunstrum's comments regarding the question of controlling the rate of shear, it should be pointed out that in the measurement of flow of non-Newtonian substances such as greases the results obtained are not absolute but are dependent upon both the geometry of the instrument and the particular conditions of operation. As long as this is kept in mind when considering practical problems the data should not be misleading.

The constant stress method of flow measurements was chosen for this apparatus primarily because of the simplicity of the dead weight system of loading. There are cases where it would be preferable to operate at constant rates of shear throughout a complete test. On the other hand a test, run with a combination of motorized passes at constant speed and measuring passes at various constant loads (such as is shown in Figs. 7, 8, and 9) gives a more complete picture of the effect of working than a test at constant rate of shear.

In considering the comments by Mr. Brunstrum and also by Mr. Gothard regarding the flow in the cylinder, it is believed that because of the low ratio of length to diameter of the cylinder the action of the piston would tend to produce practically plug flow. However, even if parabolic flow were attained, its effect would be negligible in causing variations in the rates of flow in different capillaries in the multi-hole disks. Such differences in flow in the different capillaries would be due to differences in pressure across the section of the cylinder caused by the motion of the fluid in the cylinder (neglecting minor differences in dimensions or lack of homogeneity of the fluid). Based on the assumption of parabolic flow and using a value for the velocity of the piston considerably higher than has been used in any of the tests, computations of the dynamic pressures developed indicate that the increase in pressure at the center of the cylinder above the pressure at the wall is of the order of magnitude of 1 part in 150,000 as compared to the pressure in the fluid caused by the piston when loaded with the loading yoke alone without additional weights.

This is substantiated in the calibration of the disks where it was found that with all three disks computations of capillary diameters based on flow data (corrected for piston friction) were in agreement with the measurements of diameter well within the order of accuracy with which they could be measured by ordinary gaging methods.

With reference to Mr. Kaufman's suggestion regarding the use of the apparatus for the determination of yield values, tests of this nature were made in the preliminary work with the glass syringe apparatus. In these tests a double wedge of flat taper was used under the lower plunger. This wedge was adjusted so that it just cleared the plunger by a few thousandths of an inch. Weights were then placed on the loading pan and were increased in small increments at about one-minute intervals until motion occurred as indicated by the tightness of the wedge under the plunger. With the metal apparatus a dial indicator would probably be a more convenient device for indicating movement of the pistons.

[4] Assistant Chief Chemist, Sinclair Refining Co., East Chicago, Ind.

Induction Period Calculator

By E. L. Korb[1]

SYNOPSIS

The design details and fabrication of an induction period calculator for use in such methods as A.S.T.M. test for Oxidation Stability of Gasoline (Induction Period Method) (D 525–46) is described. The use of such a device, and some of its advantages, as well as its limitations, particularly in reference to its application in conjunction with certain existing test equipment, are discussed.

ONE of the limitations of the present A.S.T.M. Standard Method of Test for Oxidation Stability of Gasoline (Induction Period Method) (D525–46),[2] is that the determination and calculation of the "induction period" are subject to human error and interpretation.

The method specifies that the technician "record the number of minutes from the time the bomb is placed in the bath until the break point has been reached as the observed induction period at the temperature of the test." The "break point" and "induction period" are defined as follows:

Break point is the point in the pressure-time curve that is preceded by a pressure drop of exactly 2 psi. within 15 min. and succeeded by a drop of not less than 2 psi. in 15 min.

Induction period is the time elapsed between the placing of the bomb in the bath and the break point at 100 C.

Experience within individual laboratories, as well as cooperative data developed between different laboratories, has shown at times rather wide discrepancies in "induction period" values obtained on the same gasoline samples. Frequently, this is due to differences in interpretation of the "break point," by the various technicians conducting the tests. Another source of error, although somewhat less frequent, is the incorrect calculation of the time elapsing between insertion of the bomb in the bath and and the "break point." There are still other errors, inherent in the test procedure, which are not ones of personal judgment, and therefore beyond the scope of this article.

Subcommittee A-I on Gum,[3] charged with the responsibility of maintaining and improving the accuracy of this method, has recognized for some time the desirability of more rigidly controlling these personal factors in the present procedure.

At a meeting of the subcommittee in January, 1947, the author presented for consideration an induction period calculator which had been developed in the du Pont Petroleum Chemicals Laboratory and used with considerable success for the past 8 yr. The interest in the possibilities of such a device was such that it was referred to the membership for consideration for inclusion in the present method, and further to suggest the desirability of describing its fabrication and use in the ASTM BULLETIN. It was recognized that such a paper would reach other users of this or similar induction period methods who are not presently members of the

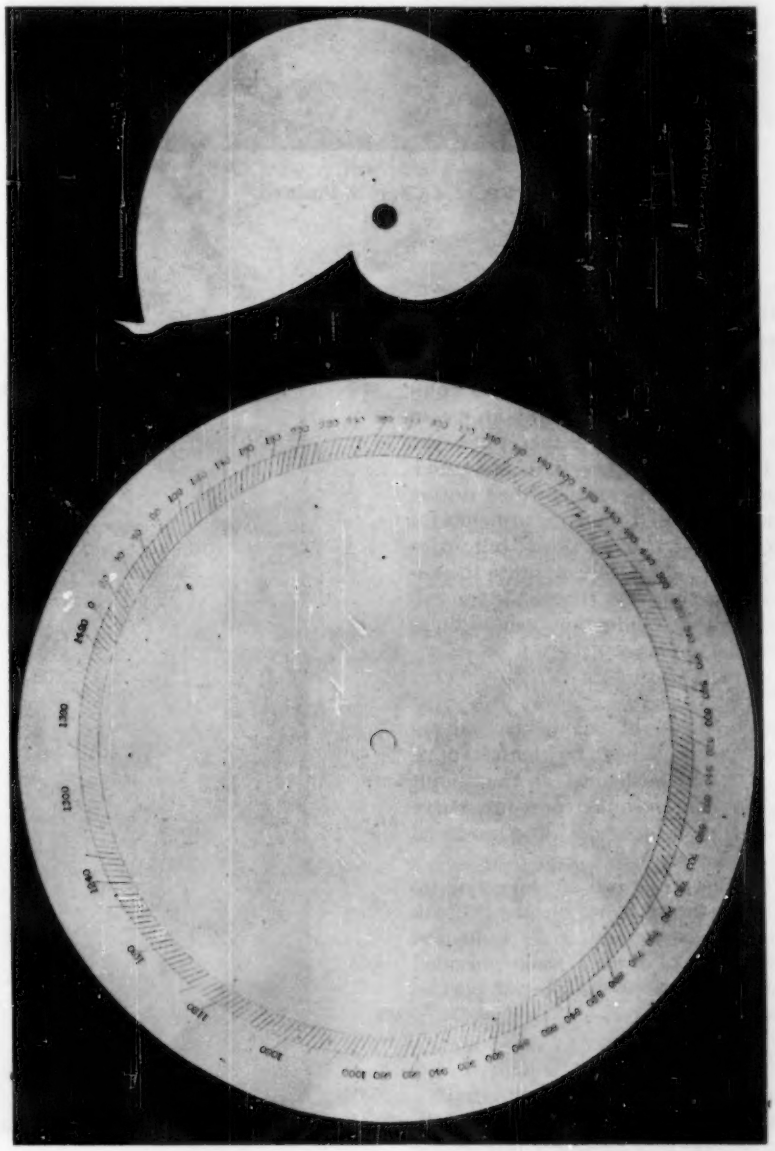

Fig. 1.—Component Parts of the Calculator.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters 1916 Race St., Philadelphia 3, Pa.

[1] Director, Petroleum Chemicals Laboratory, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.

[2] 1946 Book of A.S.T.M. Standards, Part III-A, p. 251.

[3] A.S.T.M. Committee D-2 on Petroleum Products and Lubricants, Technical Committee A on Gasoline.

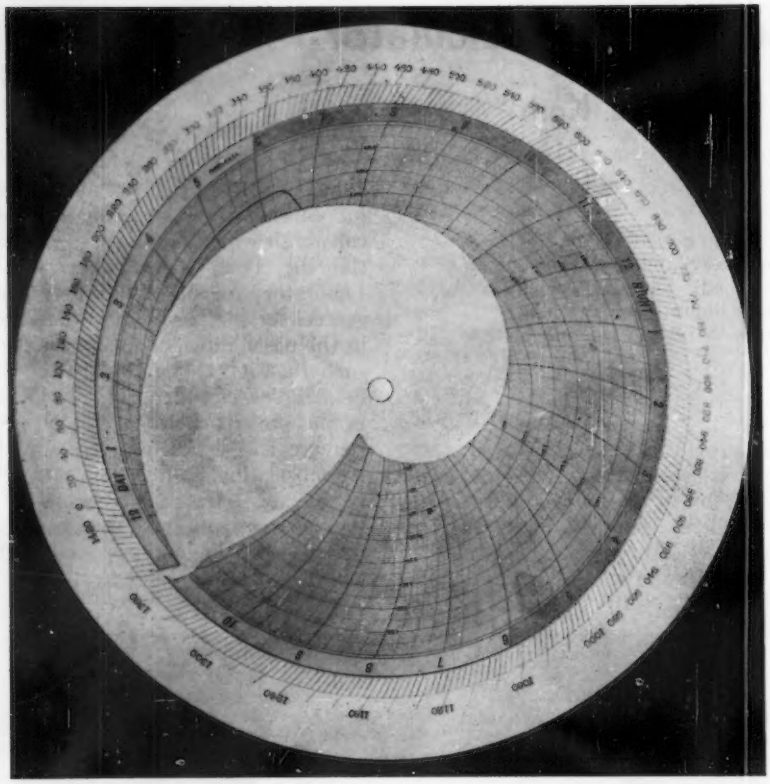

Fig. 2.—Chart in Position.

subcommittee and, in this way, a more accurate appraisal of its potential usefulness established.

The idea of an induction period calculator is not new, several other companies having spoken of units in use in their laboratories at the time the du Pont version was first presented. These calculators, as described during this meeting, used the same principle for determining the "break point" but, so far as is known, did not incorporate the additional feature of a time scale for calculating the "induction period," as herein discussed.

Principle:

The break point is quickly and accurately determined by means of a template and is defined as that point at which the recorder pressure curve drops below a tangential line produced by the template.

After the prescribed steps leading up to the determination of the "break point" are performed, the "induction period" is read from a scale provided for that purpose as an integral part of the calculator.

Operation:

The calculator (Fig. 1), consisting of a "rate of pressure change" template and a circular time platform, is operated as follows:

1. The pressure chart and template are placed on the platform (Fig. 2). The chart and template are centered by a hub in the center of the time platform.

2. The template is rotated until only a short segment of the pressure curve remains visible (that is, point at which curve has almost disappeared beneath template) and a line is drawn tangent to this curve, using a sharp, hard-lead pencil (Fig. 3).

3. The point of tangency at which the pressure curve leaves the pencil line is marked (Fig. 4). This is the point at which the pressure drop first exceeds the predetermined rate (in this case, 2 psi. per 15 min.).

4. The radial arc edge of the template is then superimposed on the pressure curve at the point where the pressure starts to increase due to immersion of the bomb in the boiling water bath. The chart and the template in the position as just described are carefully revolved until the template pointer is on the zero of the time platform (Fig. 5).

5. Holding the chart and plate firmly in place, the template is rotated until its radial arc edge coincides with the mark indicating the "break point." The "induction period" in minutes is indicated on the time platform by the template pointer (Fig. 6).

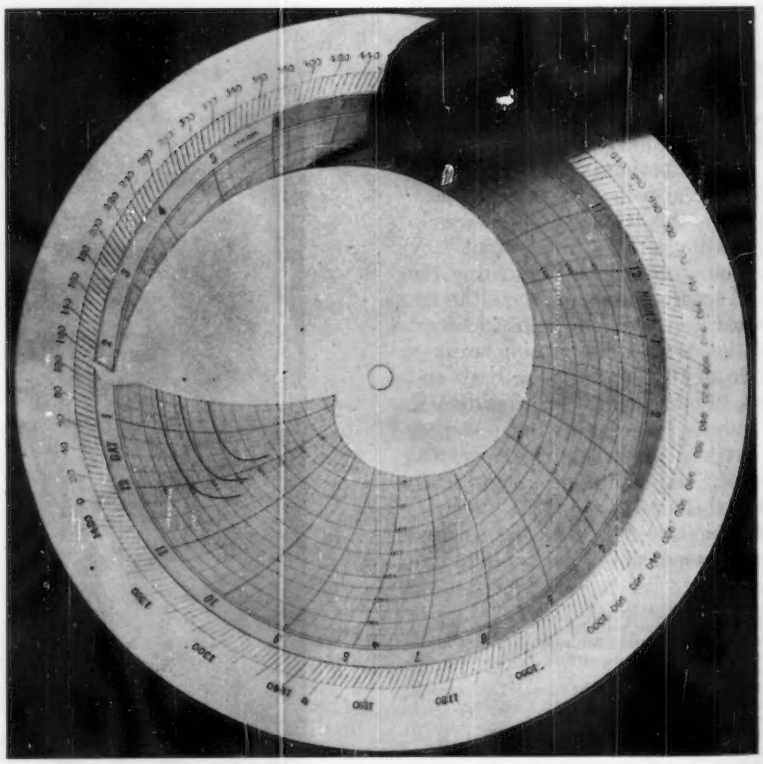

Fig. 3.—Finding the Break Point.

Discussion:

The start of the "induction period," defined by this method as the point at which pressure begins to develop, varies slightly from that of the A.S.T.M. method D 525–46[2] which gives it as the time when bombs are immersed in the boiling water bath. This difference is not considered significant.

In defining the "break point," the A.S.T.M. method states that it is the point which is preceded by a pressure drop of exactly 2 psi. in 15 min. and succeeded by a drop of not less than 2 psi. in 15 min. The Calculator Method uses the first point at which the rate of pressure drop begins to exceed the arbitrary predetermined rate as the "break point." This difference, in all but rare cases in which the pressure drop follows a 2 psi. per 15 min. slope over a long period of time, is low and consistent and does not introduce an error of sufficient magnitude to cause concern. Furthermore, either method of defining "break point" could be adopted, depending on user preference.

Probably the most critical limitations of the calculator lie in its application in conjunction with various types of existing test equipment. Theoretically, a calculator can be employed only in conjunction with the recorder pressure system and chart size for which it was designed, if the "break point" as defined is to be consistent throughout. Actually, however, the inherent error in using a single calculator for charts with moderate differences in diameter and pressure calibration is not significant. For example, the difference in "break point," using charts varying in size from 9 to 11 in. in diameter and measuring 1.0 to 1.25 in. per 50 psi. intervals (measured along the radial arc of the scale), cannot be detected. Should greater variations in chart dimensions be encountered, it may be necessary to design and fabricate more than one template.

The calculator, as illustrated in this paper, is designed for recorders whose charts rotate in a counterclockwise direction. Although it could be adapted for use with charts of clockwise rotating recorders by inverting the template, the reading of the time table becomes somewhat inconvenient since the arcs of the division lines on the dial no longer coincide with the radial arcs of the chart and template indicator.

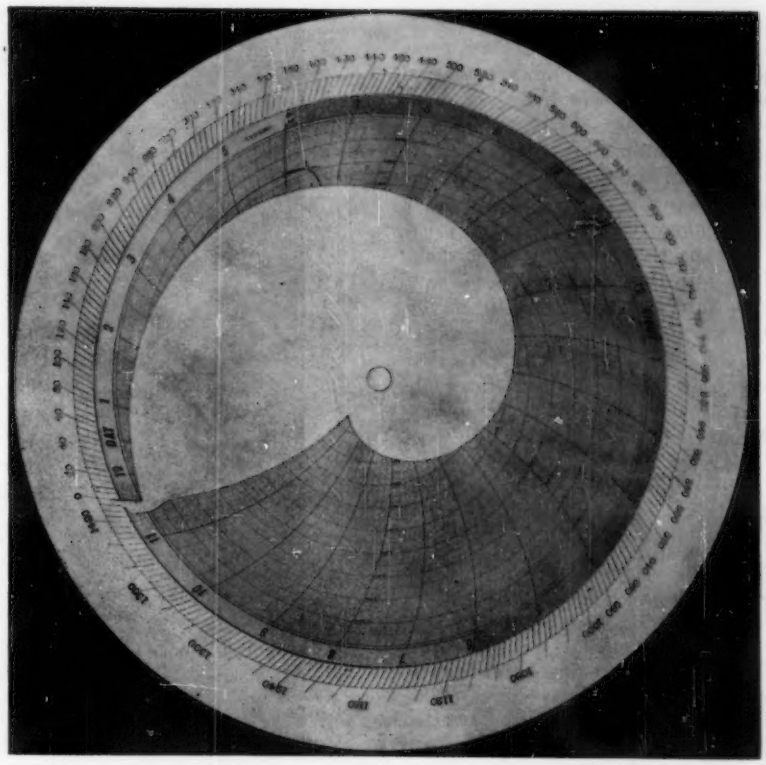

Fig. 5.—Calculating Induction Period—Zero Setting.

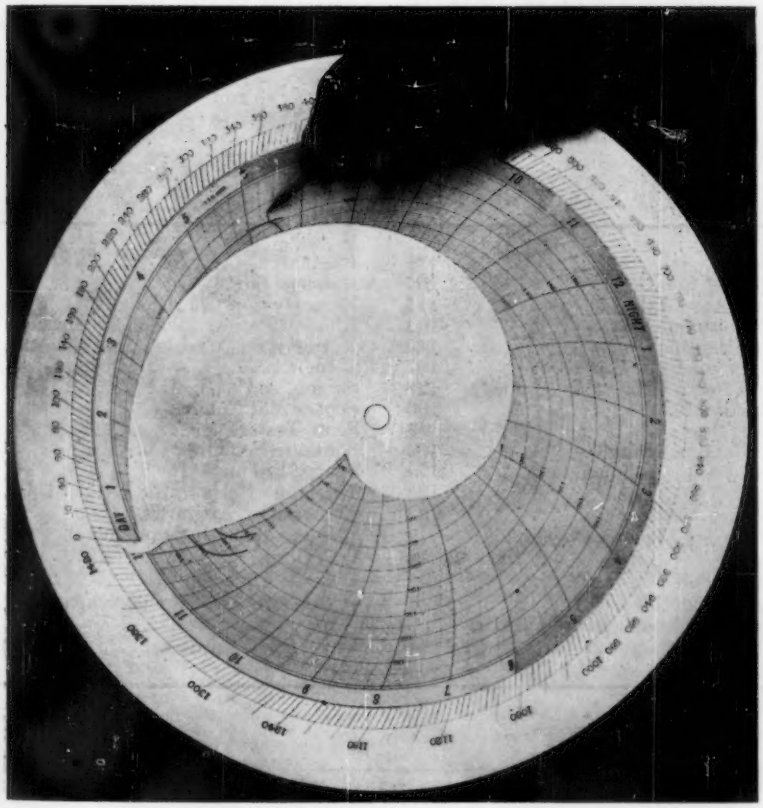

Fig. 4.—Marking the Break Point.

Fabrication of Calculator:

A relatively inexpensive calculator of plywood or cardboard for use with any particular test equipment, and of any desired rate of pressure drop, can be fabricated, using as a guide the standard pressure chart employed by the laboratory desiring such a unit.

First, a hub for the calculator is made from a wooden dowel approximately ½ in. in length and having a diameter which closely fits the center hole of the pressure recorder chart. This hub is centered on a cardboard or plywood disk, whose diameter is 2 to 3 in. larger than the chart diameter, and then permanently fastened. The pressure chart is then placed on the disk, with the hub through center hole, and the time intervals transposed from the chart to the disk by extending the radial arcs of the chart. A circular time dial is thus obtained in 15-min. intervals from 0 to 1440 min. (for a 24-hr. chart), which can then be subdivided into five-min. intervals.

A pattern for the template is made by drawing a curve with the desired slope on a chart and carefully cutting along the line. The curve is formed by plotting points at 15-min. intervals, each point representing a 2 psi. decrease in pressure from the preceding point. A French curve and sharp pencil are used to join the points. The curve is continued until it returns to the radial arc from which it started or until the lowest pressure reading on the chart is reached. Carefully cutting along this pencil line and the starting arc produces a pattern which is then transferred (including the center hole) to the cardboard or plywood. Before cutting out the latter, the starting radial arc should be projected beyond the periphery of the template approximately ¾ in. to form an indicator to be used in reading the minutes from the time dial.

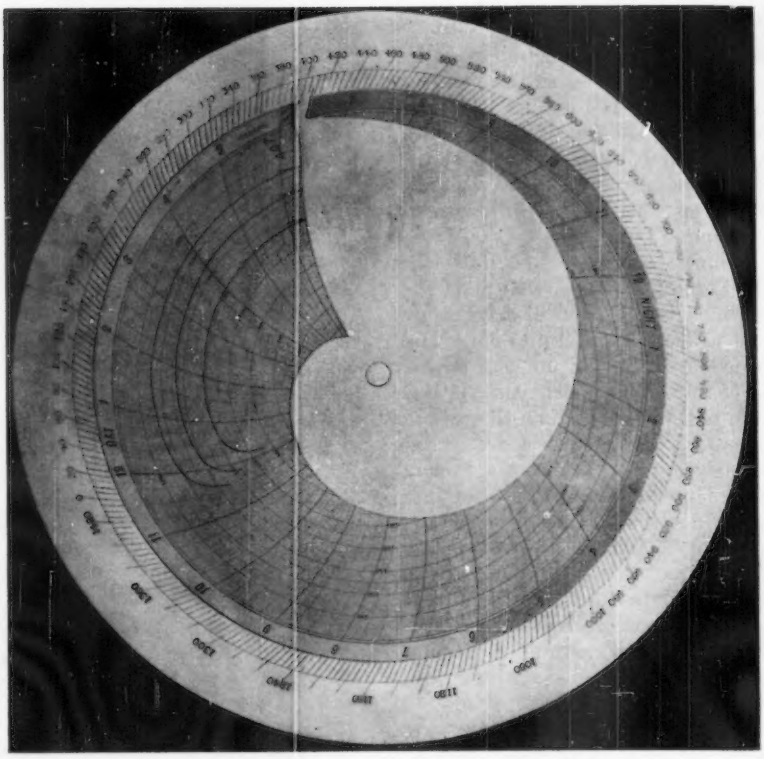

FIG. 6.—**Calculating Induction Period—Final Reading.**

Acknowledgment:

The author wishes to acknowledge that this calculator is an outgrowth of a suggestion originally made by Mr. Charles Wirth III, presently Manager of the Mid-Continent District Office of the du Pont Petroleum Chemicals Division, Tulsa, Okla.

He would also like to express his appreciation to members of the Petroleum Chemicals Laboratory for their assistance in preparing this paper.

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